
BIOSTRATIGRAPHY OF UINTAN AND DUCHESNEAN LAND MAMMAL ASSEMBLAGES FROM THE MIDDLE MEMBER OF THE SESPE FORMATION, SIMI VALLEY, CALIFORNIA

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ABSTRACT. The Sespe Formation is composed of middle Eocene to upper Oligocene continental strata exposed along the northern side of Simi Valley, Ventura County, California. In this area, the Sespe Formation is divided into three (lower, middle, upper) members. The lower part of the middle member has yielded middle and late Eocene land mammal assemblages. A general section of this part of the formation consists of 22 sandstone (SS) beds, each overlain by a claystone (CS) bed. In ascending order, these beds are numbered 1 through 22.

Three late Eocene local faunas were previously recognized from the lower part of the middle member: the late Uintan Tapo Canyon and Brea Canyon Local Faunas and the Duchesnean Pearson Ranch Local Fauna. However, a fourth local fauna can be recognized. Each local fauna is characterized by a distinctive suite of assemblages stratigraphically restricted to a particular interval within the section. The Tapo Canyon Local Fauna, stratigraphically lowest in the middle member, includes the assemblages from beds CS1 through the lower part of SS2. The Brea Canyon Local Fauna consists of the assemblages from beds CS2 through CS6 and lies about 50 to 100 m stratigraphically above the Tapo Canyon Local Fauna. The Pearson Ranch Local Fauna as recognized by previous workers in Simi Valley actually consists of two stratigraphically and taxonomically distinct local faunas: the Strathern Local Fauna (new) and the Pearson Ranch Local Fauna (restricted). The latest Uintan or earliest Duchesnean Strathern Local Fauna is comprised of the assemblages from beds CS8 through CS14 and lies about 200 to 300 m above the Tapo Canyon Local Fauna. The early Duchesnean Pearson Ranch Local Fauna is redefined to include only the fossil assemblages from the upper part of bed SS15 through bed SS22 and lies about 315 to 475 m above the Tapo Canyon Local Fauna.

New Uintan taxa and occurrences recorded from Simi Valley are *Macrotarsius roederi* n. sp.; *Leptoreodon pusillus* Golz, 1976; *Leptoreodon stocki* n. sp.; and *Protylopus?* sp., cf. *P. robustus* Golz, 1976. New Duchesnean taxa and occurrences recorded from Simi Valley are *Leptoreodon* sp., cf. *L. pusillus* Golz, 1976; *Leptoreodon stocki* n. sp.; and *Rapamys* sp. indet.

INTRODUCTION

The Sespe Formation, which is exposed along the north side of Simi Valley, Ventura County, California, is one of the few stratigraphic sequences on the Pacific Coast of North America to produce middle and late Eocene land mammal assemblages. The most fossiliferous outcrops in Simi Valley are

present in the Brea Canyon area, which includes lower Alamos and Brea Canyons and the unnamed canyon between Alamos and Brea Canyons (Fig. 1).

The Sespe Formation was first extensively investigated during the 1930's by parties from the California Institute of Technology (CIT), Pasadena, under the direction of Chester Stock. In a series of papers, Stock (1932, 1934b, 1935a, 1936a,b, 1939) described many new species and defined two faunas—the Pearson Ranch Fauna and the Tapo Ranch Fauna [= combined Tapo Canyon and Brea Canyon Local Faunas of Golz (1976)]. The CIT collection

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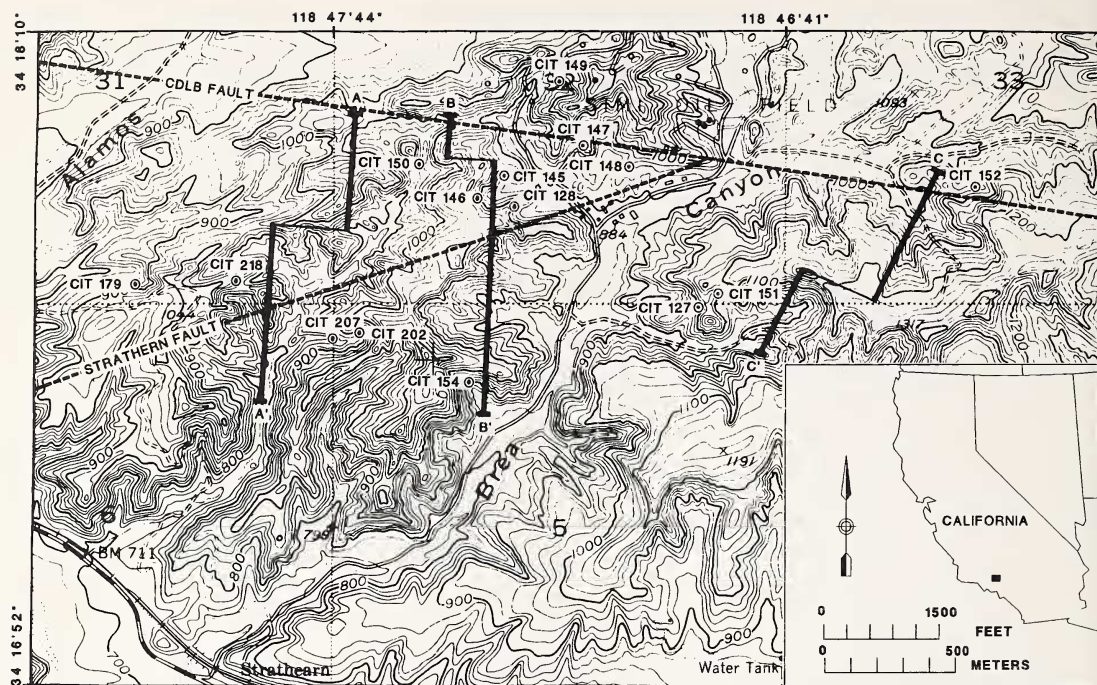


Figure 1. Map of Brea Canyon area showing locations of Strathern and Cañada de la Brea faults, key LACM(CIT) vertebrate fossil localities, and measured sections. Base map: U.S.G.S. 7.5 minute, Simi, Calif. quadrangle (scale 1:24,000), 1951, photorevised 1969.

was later transferred to the Natural History Museum of Los Angeles County (LACM), where it is presently housed. Since then, parties from the LACM and the University of California Museum of Paleontology (UCMP) have discovered additional localities in Simi Valley.

Only general summaries of the stratigraphic relations of the LACM(CIT) localities have been published (Stock, 1932; Golz, 1976; Golz and Lillegraven, 1977). Many localities in the unnamed canyon between Brea and Alamos Canyons, including LACM(CIT) locs. 150, 150.5, 202, 202E, 200W, and 207, were destroyed by the Simi Valley Landfill. These localities produced most of the specimens comprising the Brea Canyon and Pearson Ranch Local Faunas. Rapid urban development north of the Simi Valley Freeway (California 118) at the entrance to Brea Canyon is threatening many additional localities. Because of the importance of the land mammal assemblages from the Sespe Formation in Simi Valley and the continuing loss of fossil-bearing exposures, the present study was begun in the spring of 1977 to recover fossil remains and stratigraphic data that might otherwise have been lost to earth-moving activities. As the result of 11 years of field investigation, several hundred new specimens were recovered, all of the LACM(CIT) localities were relocated or their stratigraphic horizons identified, 34 new localities (LACM locs. 5616 through 5649, 5660) were discovered in Brea Canyon, and five new localities (LACM locs.

5611 through 5615) were recorded from the adjacent lower Alamos Canyon.

The goals of the study, described herein, are 1) to clarify the stratigraphic relations of the LACM(CIT), LACM, and UCMP localities; 2) to taxonomically and stratigraphically define the land mammal assemblages from the Sespe Formation in Simi Valley; and 3) to correlate the Uintan and Duchesnean assemblages from Simi Valley with other middle and late Eocene land mammal assemblages in California, Texas, Utah, and Wyoming.

METHODS AND MATERIALS

As part of the present study, exposures of the Sespe Formation in Simi Valley were prospected for identifiable fossils, and each fossiliferous horizon was traced to adjacent outcrops. The locations of the LACM(CIT) localities were determined by 1) a review of the original locality descriptions in the CIT locality catalog and of photographs taken during the CIT field investigations (Sespe Excavations 1933, catalog and photographs now filed in the LACM archives), 2) examination of aerial photographs of the area, and 3) subsequent field investigation. In some cases, the location of a fossil locality was confirmed by the discovery of the original marking post in the field.

Stratigraphic sections were measured to the nearest 0.25 m with a Jacob's staff. Correlation of beds from section A-A' (west side of the Simi Valley Landfill) to section B-B' (west side of Brea Canyon) was accomplished by tracing key marker beds in the field and using the

detailed geologic map prepared by Emcon Associates (1986). The contact between the lower and middle members of the Sespe Formation as defined by Taylor (1983, fig. 3) is used herein.

Statistical tests followed the format recommended by Simpson *et al.* (1960) and were run using computer programs compiled by Peters (1971) and Poole and Borchers (1979). A 95% or greater level of confidence was considered to represent a significant difference between samples, and all Student's *t*-tests were two-sided.

Potassium-argon dates cited in this report were recalculated using the new constants proposed by Steiger and Jager (1978) and the conversion factors presented by Dalrymple (1979).

Measurements of large teeth were made to the nearest 0.1 mm with a vernier caliper, and those of smaller teeth were made to the nearest 0.01 mm with an AO optical micrometer. All measurements are in millimeters, and all teeth were measured at their greatest dimensions. All metric abbreviations, dental formulae, and terminology follow standard usage.

Institutional acronyms are as follows:

CIT—California Institute of Technology
LACM—Natural History Museum of Los Angeles County
LACM(CIT)—California Institute of Technology locality number, files and specimens now held by LACM; CIT abbreviation for localities used in figures
RV—UCR vertebrate fossil locality
TMM—Texas Memorial Museum
UCR—University of California, Riverside
UCMP—University of California Museum of Paleontology
V—UCMP vertebrate fossil locality

Abbreviations are as follows:

CDLB—Cañada de la Brea
CS—claystone
ft—foot
K—Ar—potassium-argon
Lat.—latitude
loc.—locality
Long.—longitude
Ma—megannum (million years before present)
NALMA—North American Land Mammal Age
SS—sandstone

Abbreviations of anatomical terms are as follows:

A—P—anteroposterior
ANT—anterior
L—left
POST—posterior
R—right
TAL—talonid
TR—transverse
TRI—trigonid

GEOLOGIC SETTING

The northern side of Simi Valley contains over 7100 m of upper Cretaceous to Pleistocene marine and nonmarine strata and minor submarine volcanics (Squires and Filewicz, 1983). The upper middle Eocene to upper Oligocene nonmarine Sespe Formation in Simi Valley consists of 1656 m of sand-

stone, conglomerate, and mudstone (Taylor, 1983).

Previous workers divided the Sespe Formation in Simi Valley into three (lower, middle, upper) members (Stock, 1932; Taylor, 1983; Mason, 1988). The lower member of the Sespe Formation rests unconformably on the lower middle Eocene marine Lajas Formation, and the upper member interfingers with the overlying upper Oligocene to lower Miocene marine Vaqueros Formation (Lander, 1983). The members have gradational contacts with each other (Taylor, 1983).

The middle member is composed of alternating tabular beds of structureless yellow to gray sandstone and mottled red and green claystone, interpreted by Taylor (1983) to represent a meandering-river flood-basin facies. Taylor (1983) determined that the sand comprising the sandstone beds was deposited by sheet floods at maximum flood-stage, and the clay composing the claystone beds was deposited from suspension during waning flood-stage or as flood-basin deposits. Calcrete nodules are present in some claystone beds indicating partial pedogenesis (Taylor, 1983). The sandstone and claystone beds have marked horizontal continuity in the Brea Canyon area and can be traced between widely separated exposures.

Two north-dipping reverse faults, the Strathern and Cañada de la Brea (CDLB) faults (Fig. 1), are present in the Brea Canyon area (Taylor, 1983; Kimmel *et al.*, 1983). Well log data from the Unocal CDLB #7 and CDLB #14 wells in Brea Canyon indicate strata along the CDLB fault are offset vertically by approximately 262 m (860 ft) with the north side up, and strata along the Strathern fault are offset vertically by approximately 46 to 55 m (150 to 180 ft) with the south side up (Kimmel *et al.*, 1983). These well log data also indicate the strata between the faults comprise a down-dropped fault block, with approximately 46 to 55 m of section removed just above the Strathern fault and approximately 262 m of section repeated above the CDLB fault (Figs. 2, 3).

MEASURED SECTIONS

Three composite sections were measured and their beds correlated (Figs. 1, 3). Section A-A' begins at the CDLB fault on the west side of the Simi Valley Landfill (west side of unnamed canyon between Brea and Alamos Canyons) and traverses southward and down section to the contact between the lower and middle members near the landfill entrance. Section B-B' begins at the CDLB fault between LACM(CIT) locs. 145 and 150 and traverses southward along the west side of Brea Canyon (west Brea Canyon) down section to the contact between the lower and middle members, stratigraphically below LACM(CIT) loc. 154. Section C-C' begins just above the CDLB fault in the vicinity of LACM(CIT) loc. 152 and traverses southwestward down section to the contact between the lower and middle members

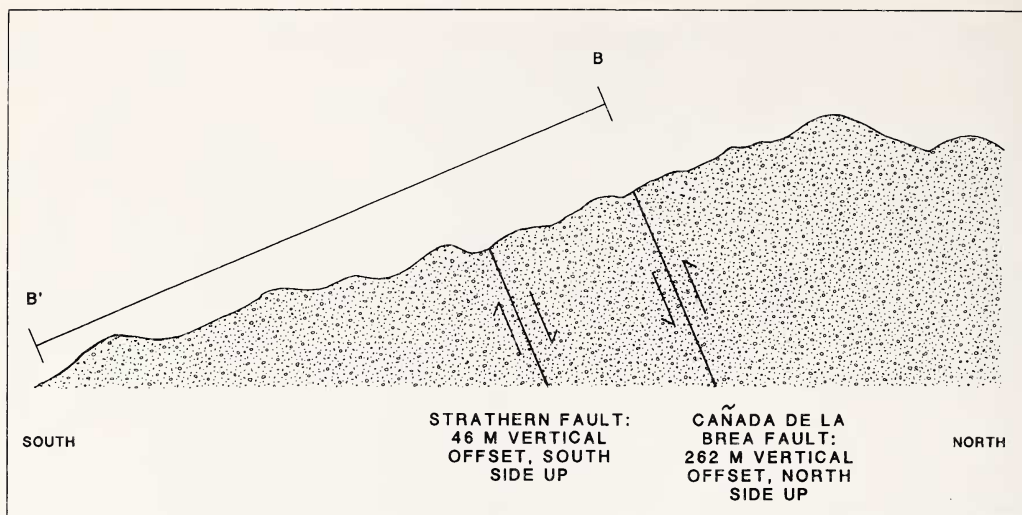


Figure 2. Stratigraphic relationships of beds between Strathern and Cañada de la Brea (CDLB) faults in area of section B-B' (see Fig. 1). Strata along Strathern fault offset vertically approximately 46 to 55 m (150 to 180 ft) with south side up; strata along Cañada de la Brea fault offset vertically approximately 262 m (860 ft) with north side up. Strata between faults comprise a down-dropped fault block, with approximately 46 to 55 m (150 to 180 ft) of section missing above Strathern fault and approximately 262 m (860 ft) of section repeated above Cañada de la Brea fault.

in a tributary extending eastward from Brea Canyon (east Brea Canyon).

A general stratigraphic section of the lower part of the middle member in the Brea Canyon area (Fig. 4) was constructed from the three measured sections (Fig. 3). The general section consists of 22 major structureless sandstone (SS) beds, each overlain by a mottled claystone (CS) bed and numbered, in ascending order, 1 through 22 (Fig. 4).

Sections A-A' and B-B' were correlated directly by tracing 23 key beds between these sections in the field. Accurate correlation of sections B-B' and C-C' is based on tracing beds SS7 and SS8 across Brea Canyon from the roadcut in west Brea Canyon to the stream bank in the canyon floor and into east Brea Canyon. Moreover, the contact between the lower and middle members is present in sections B-B' and C-C'.

The sandstone beds exhibit distinct weathering characteristics that allow correlation across areas of thick chaparral cover, even when the interbedded claystone beds become thin or discontinuous. However, some sandstone beds can change in thickness or lithology over short distances. For example, in the canyon that contains LACM(CIT) loc. 145, bed SS17 varies laterally from a 10-m-thick, yellowish-buff sandstone that weathers into vertical columns to a 5-m-thick, coarse-grained, clayey, structureless, light-gray sandstone, and then to a 6-m-thick, coarse-grained yellowish-gray sandstone.

It cannot be determined if the discontinuous claystone beds were deposited during the waning stage of the same or different flood events; however, their presence at the same stratigraphic levels over

great distances suggests they represent isochronous events.

VERTEBRATE FOSSIL LOCALITIES

Previous workers determined the stratigraphic positions of the vertebrate fossil localities in the Sespe Formation based on their distances above the base of the formation (Stock, 1932; Mason, 1988). Kelly and Lander (1988) noted that inaccuracies in the determination of the relative stratigraphic positions of fossil localities can occur when these determinations are based on distances of localities above or below a stratigraphic datum, such as the top or base of a formation. These inaccuracies result from variation in the thicknesses of individual beds along strike. Such variation occurs in the Brea Canyon area. For example, in east Brea Canyon the sequence consisting of beds SS1 through SS7 in the vicinity of LACM(CIT) loc. 127 is about 40 m thinner than the same sequence in west Brea Canyon.

To avoid such inaccuracies, the bed that produced each fossil locality was determined and traced laterally to other exposures. This process allowed documentation of the stratigraphic levels of most of the fossil localities to be accurately placed within the general section (Fig. 4); however, the stratigraphic positions of a few localities can only be estimated. LACM(CIT) loc. 149 lies above the CDLB fault in a part of the section that is repeated below the fault. Based on lithologic similarities and vertical displacement along the fault, the stratigraphic position of LACM(CIT) loc. 149 appears to be in bed CS8 (Fig. 4). The bed that contains LACM(CIT) loc. 152, which is also in strata repeated above the

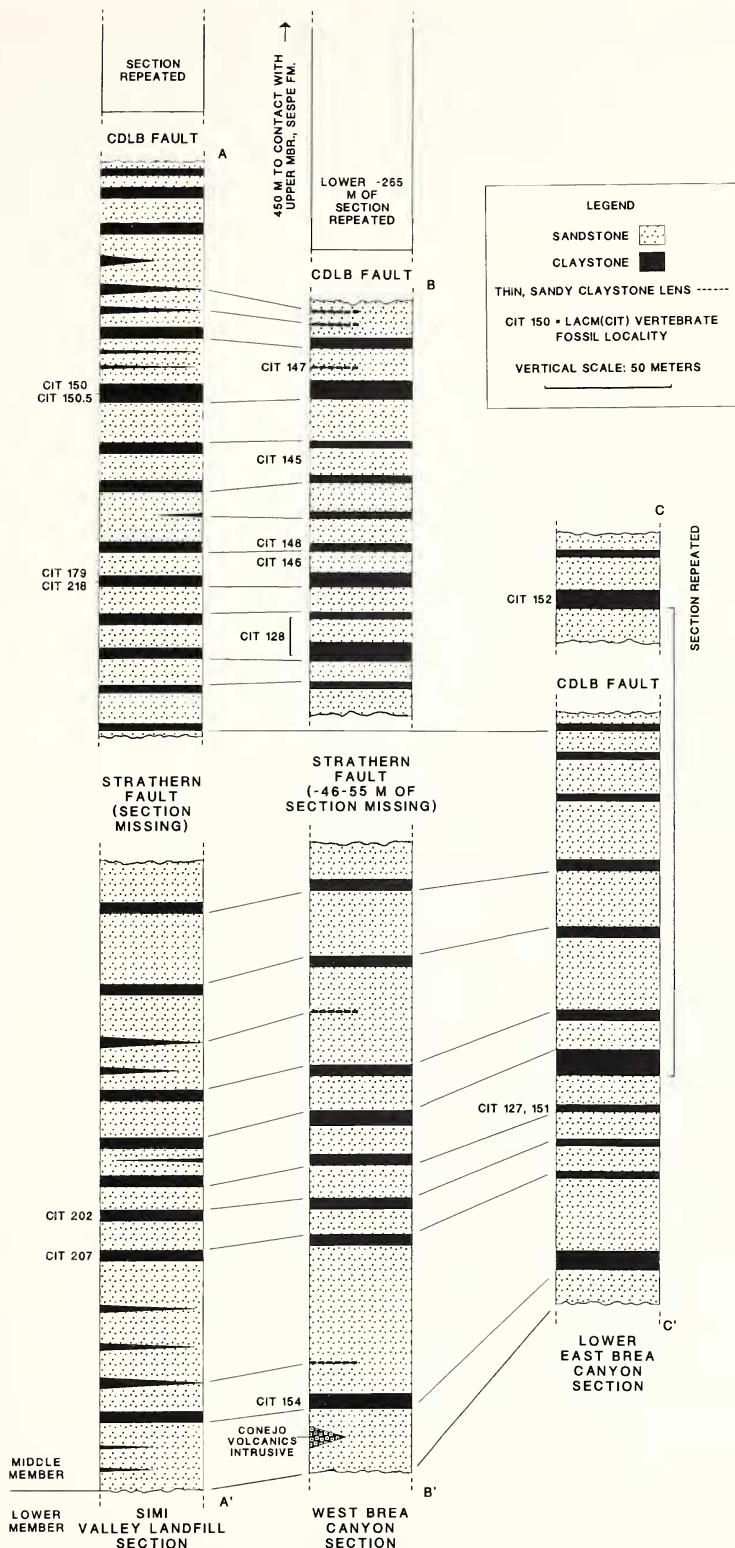


Figure 3. Correlation of sections A-A', B-B', and C-C' in lower part of middle member of Sespe Formation in Simi Valley and stratigraphic positions of key LACM(CIT) vertebrate fossil localities.

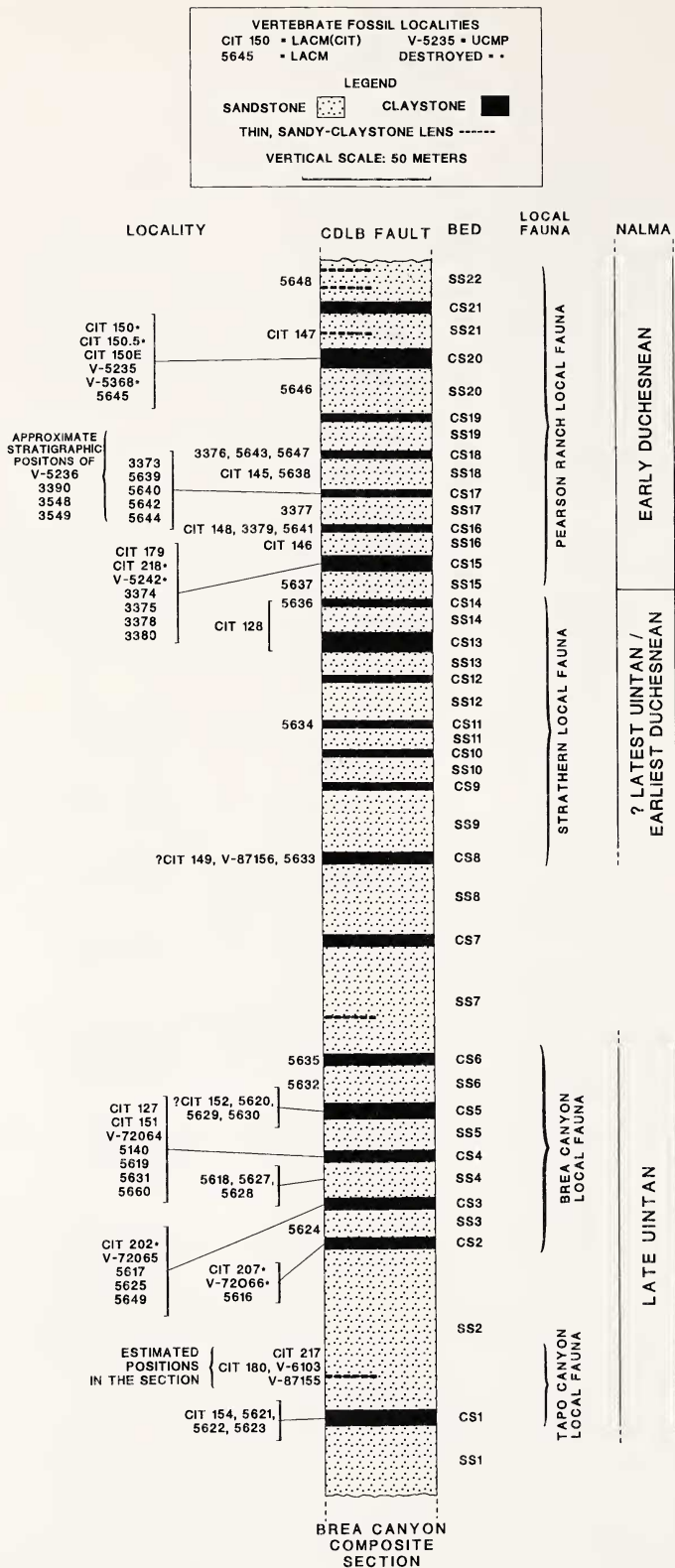


Figure 4. Generalized stratigraphic section of lower part of middle member of Sespe Formation in Brea Canyon area, based on sections A-A', B-B', and C-C' (see Fig. 3) and showing stratigraphic positions of vertebrate fossil localities and local faunas.

CDLB fault, is correlated with bed CS5 on the basis of similar lithology. The LACM(CIT) locs. 180 and 217 are present in Dry Canyon, which lies about 2 miles east of the Brea Canyon area. The stratigraphic positions of LACM(CIT) locs. 180 and 217 are very low in the middle member; however, it is difficult to trace individual beds from Dry Canyon to Brea Canyon. The stratigraphic positions of LACM(CIT) locs. 180 and 217 are within approximately 20 m of bed CS1 in Brea Canyon.

Figure 4 shows the stratigraphic relations of the vertebrate fossil localities and local faunas of Simi Valley. The stratigraphic ranges of the taxa within the Brea Canyon section and from the Dry Canyon localities are shown in Table 1. Descriptions and stratigraphic horizons of all the LACM(CIT) localities in Simi Valley, as well as the taxa these localities yielded during the present study, are presented in the Appendix.

SYSTEMATIC PALEONTOLOGY

Golz and Lillegraven (1977) listed the majority of taxa from the Sespe Formation in Simi Valley. Included here are new taxa, new material representing poorly known taxa, and chronologic range extensions.

Order Primates
Infraorder Tarsiiformes
Gregory, 1915
Family Omomyidae
Trouessart, 1879
Subfamily sp. Omomyinae
Trouessart, 1879
Genus *Dyseolemur*
Stock, 1934a
Dyseolemur pacificus
Stock, 1934a
Figure 5

Dyseolemur pacificus Stock, 1934a:954–959, pl. 1, figs. 1–3.

MATERIAL. LACM 128888, partial right dentary with partial M₁ and M₂.

LOCALITY. LACM(CIT) 128.

AGE AND FAUNA. Latest Uintan or earliest Duchesnean, Strathern Local Fauna.

DISCUSSION. The M₁ of LACM 128888 is badly damaged. The M₂, well preserved with only slight wear, has the diagnostic characters of *Dyseolemur*, including a metastylid and a short paracristid between the paraconid and protoconid. Dimensions of M₂ are A–P = 2.24, TRI–TR = 1.92, and TAL–TR = 1.95. The M₂ is morphologically indistinguishable from that of *D. pacificus* from the Brea Canyon Local Fauna.

Dyseolemur pacificus was previously known from the late Uintan Brea Canyon, Tapo Canyon, and Laguna Riviera Local Faunas (Golz and Lillegraven, 1977) and is also recorded in the latest Uintan or earliest Duchesnean Camp San Onofre Local Fauna (Lillegraven, 1980). The recovery of *D. pacificus* from LACM(CIT) loc. 128 represents the highest stratigraphic occurrence of this species in Simi Valley.

Genus *Macrotarsius*
Clark, 1941
Macrotarsius roederi
new species

Figure 6; Table 2

HOLOTYPE. LACM 128928, partial right dentary with I₂ root, canine root, and P₂–M₃.

TYPE LOCALITY. LACM 5660.

AGE AND FAUNA. Late Uintan, Brea Canyon Local Fauna.

ETYMOLOGY. Named in honor of Mark A. Roeder, whose contributions to vertebrate paleontology include the recovery of large samples of Eocene fossil vertebrates from marine and non-marine deposits in southern California over the last 20 years. Mr. Roeder discovered the type specimen of *M. roederi* while screen washing matrix from the Sespe Formation during an ongoing mitigation program at the Simi Valley Landfill.

DIAGNOSIS. Differs from *Macrotarsius jepseni* Robinson, 1968, in having the following characters: molars uncrowded, premolars and molars equally spaced, resulting in greater P₃–M₃ length; lack of distinct diastema between P₂ and P₃; P₃ paraconid smaller; P₄ larger, less reduced relative to molars, trigonid more well defined; M₃ smaller, narrower; accessory crests of metaconids and paraconids less complete; ramus deeper, more robust. Differs from *Macrotarsius siegerti* Robinson, 1968, and *Macrotarsius montanus* Clark, 1941, in having the following characters: premolars and molars much less crowded; P₂ much less reduced; P₄ less reduced relative to molars; lower molars smaller; accessory crests of metaconids and paraconids less developed. It further differs from *M. siegerti* in having larger P₄ and narrower M₃. It further differs from *M. montanus* in having longer and narrower P₄, and much smaller lower molars. Differs from *Ourayia uintens* (Osborn, 1895), in having the following characters: P₃ not taller than P₄; P₄ trigonid more molariform; P₄ paraconid distinct and placed more anterolingually; molar cusps with accessory crests; metaconids prominent. Differs from *Hemiacodon gracilis* Marsh, 1872, in having the following characters: P₂ less reduced; P₃ not taller than P₄; premolars and molars less crowded; metaconids and paraconids with accessory crests; lower molars quadrate with less expanded talonids; cristae obliqua connected to posterior base of protoconids

Table 1. Stratigraphic ranges of Eocene mammalian taxa in Simi Valley. Systematic list modified from Golz and Lillegraven (1977), Savage and Russell (1983), Black and Sutton (1984), Mason (1988), and the results of the present study. Fossiliferous horizons included below each local fauna (LF) are in relative stratigraphic positions from lowest (CS1) to highest (SS22). Additional key references included in brackets. DCLOCS. refers to Dry Canyon localities LACM(CIT) 180 and 217.

Taxa	Tapo Canyon LF		Brea Canyon LF				
	CS1	DCLOCS.	CS2	CS3	SS4	CS4	CS5
Marsupialia							
Didelphidae							
<i>Peratherium</i> sp., cf. <i>P. knighti</i> McGrew, 1959 [Lillegraven, 1976]	—	X	—	X	—	—	—
<i>Peradectes californicus</i> (Stock, 1936a) [Krishtalka and Stucky, 1983]	—	—	—	X	—	—	—
Pantolesta							
Pantolestidae							
<i>Simidectes merriami</i> Stock, 1933b	—	—	—	—	—	—	—
Apatotheria							
Apatemyidae							
<i>Apatemys downsi</i> Gazin, 1958 [Walsh, 1987]	—	X	—	—	—	—	—
Creodonta							
Hyaenodontidae							
<i>Hyaenodon vetus</i> Stock, 1933a	—	—	—	—	—	—	—
<i>Hyaenodon venturae</i> Mellett, 1977	—	—	—	—	—	—	—
Carnivora							
Miacidae							
<i>Procyonodictis progressus</i> (Stock, 1935b) [Mason, 1988]	—	X	X	—	—	—	—
<i>Miacis? hookwayi</i> Stock, 1934c	—	X	—	—	—	—	—
<i>Tapocyon occidentalis</i> Stock, 1934c	—	X	—	X	—	—	—
Insectivora							
Dormaliidae							
<i>Sespedectes singularis</i> Stock, 1935c	X	X	X	X	—	X	—
<i>Proterixoides davisii</i> Stock, 1935c	—	X	X	X	—	X	—
Primates?							
Microsyopidae							
<i>Craseops sylvestris</i> Stock, 1934b	—	X	—	—	—	—	—
Primates							
Omomyidae							
<i>Phenacolemur</i> sp., cf. <i>P. shifrae</i> Robinson, 1968 [Mason, 1988]	—	X	—	—	—	—	—
<i>Dyseolemur pacificus</i> Stock, 1934a	—	X	X	X	—	—	—
<i>Chumashius balchi</i> Stock, 1933d	—	—	—	—	—	—	—
<i>Macrotarsius roederi</i> n. sp. [this paper]	—	—	—	X	—	—	—
Omomyid n. gen. and sp. [Mason, 1988]	—	X	—	—	—	—	—
Perissodactyla							
Brontotheriidae							
<i>Duchesneodus californicus</i> (Stock, 1935d) [Lucas and Schoch, 1982]	—	—	—	—	—	—	—
Helaletidae							
<i>Dilophodon</i> sp. [Stock, 1936c]	—	X	—	—	—	—	—
Hyracodontidae							
<i>Triplopus? woodi</i> Stock, 1936c	—	—	—	—	—	—	—
Aminodontidae							
<i>Aminodon</i> sp., cf. <i>A. advenus</i> Marsh, 1875 [Stock, 1939]	—	—	X	—	X	—	—
<i>Aminodontopsis bodei</i> Stock, 1933c	—	—	—	—	—	—	—
Artiodactyla							
Dichobunidae							
<i>Tapochoerus egressus</i> (Stock, 1934b)	—	X	X	X	—	—	—

Table 1. Extended.

[illegible]

Table 1. Continued.

Taxa	Tapo Canyon LF		Brea Canyon LF				
	CS1	DCLOCS.	CS2	CS3	SS4	CS4	CS5
Agriochoeridae							
<i>Protoreodon</i> “ <i>pumilus</i> ” [Golz, 1976; this paper]	—	X	X	X	—	X	—
<i>Protoreodon pacificus</i> Golz, 1976	—	—	—	—	—	—	—
Protoceratidae							
<i>Leptoreodon edwardsi</i> Stock, 1936b	—	X	—	—	—	—	—
<i>Leptoreodon stocki</i> n. sp. [this paper]	X	—	X	X	X	X	X
<i>Leptoreodon pusillus</i> Golz, 1976	—	—	—	—	—	—	X
<i>Leptoreodon</i> sp., cf. <i>L. pusillus</i> [this paper]	—	—	—	—	—	—	—
Oromerycidae							
<i>Protylopus</i> sp., cf. <i>P. petersoni</i> Wortman, 1898 [Golz, 1976]	—	—	—	X	—	—	—
<i>Protylopus pearsonensis</i> Golz, 1976	—	—	—	—	—	—	—
<i>Protylopus stocki</i> Golz, 1976	—	—	X	X	—	—	—
<i>Protylopus? robustus</i> Golz, 1976	—	—	X	—	—	—	—
<i>Protylopus?</i> sp., aff. <i>P. robustus</i> Golz, 1976	—	—	X	—	—	—	—
<i>Protylopus</i> sp., cf. <i>P.? robustus</i> Golz, 1976 [this paper]	—	—	—	—	X	—	—
<i>Eotylopus</i> sp. [Golz, 1976]	—	—	—	—	—	—	—
Hypertragulidae							
<i>Simimeryx hudsoni</i> Stock, 1934d	—	—	—	—	—	—	—
<i>Simimeryx</i> n. sp. [Mason, 1988]	—	X	—	—	—	—	—
Rodentia							
Ischyromyidae							
<i>Leptotomus</i> sp., cf. <i>L. caryophyllus</i> Wilson, 1940a [Golz and Lillegraven, 1977]	—	X	—	—	—	—	—
<i>Leptotomus</i> sp., cf. <i>L. leptodus</i> (Cope, 1873) [Golz and Lillegraven, 1977]	—	X	—	—	—	—	—
<i>Tapomys tapensis</i> (Wilson, 1940a)	—	X	—	—	—	—	—
<i>Tapomys</i> sp. [Mason, 1988]	—	—	X	—	—	—	—
<i>Mytonomys burkei</i> (Wilson, 1940a)	—	—	X	X	X	—	—
<i>Mytonomys</i> sp., cf. <i>M. mytonensis</i> (Cope, 1873) [Mason, 1988; this paper]	—	—	—	—	—	—	—
<i>Microparamys</i> sp. D [Wood, 1962]	—	X	—	—	—	—	—
<i>Microparamys tricus</i> (Wilson, 1940a)	—	—	—	—	—	—	—
<i>Ischyrotomus</i> sp., cf. <i>I. compressidens</i> (Peterson, 1919) [Wood, 1962]	—	X	—	—	—	—	—
<i>Rapamys fricki</i> Wilson, 1940a	—	—	X	—	—	—	—
<i>Rapamys</i> sp. [Golz and Lillegraven, 1977]	—	—	—	X	—	—	—
<i>Rapamys</i> sp. indet. [this paper]	—	—	—	—	—	—	—
Ischyromyidae?							
<i>Eohaplomys tradux</i> Stock, 1935a	—	X	—	—	—	—	—
<i>Eohaplomys serus</i> Stock, 1935a	—	—	X	—	—	—	—
<i>Eohaplomys matutinus</i> Stock, 1935a	—	—	—	X	—	X	—
Cylindrodontidae							
<i>Pareumys</i> sp. [Wilson, 1940c]	X	—	—	X	—	—	—
<i>Pareumys</i> sp., near <i>P. milleri</i> Peterson, 1919 [Wilson, 1940c; this paper]	—	—	X	—	—	—	—
<i>Presbymys lophatus</i> Wilson, 1949	—	—	—	—	—	—	—
Family ?Geomyidae							
<i>Griphomys alecer</i> Wilson, 1940b	—	—	X	X	—	—	—
Family ?Zapodidae							
<i>Simimys simplex</i> (Wilson, 1935a) [Wilson, 1935b]	—	X	X	X	—	—	—

Table 1. Extended, Continued.

[illegible]

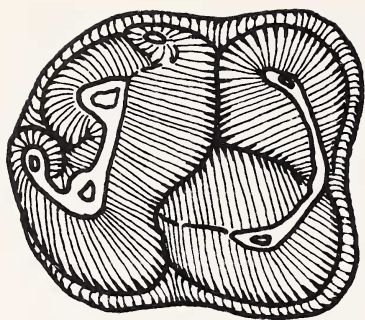


Figure 5. *Dyseolemur pacificus* Stock, RM₂, LACM 128888; occlusal view. Scale = 1 mm.

and positioned more labially; M₁₋₂ lacking hypoconulids; horizontal ramus straighter.

DESCRIPTION. *Macrotarsius roederi* is known only from the holotype. The I₂ is represented by the root, which is unpaired and anteroposteriorly compressed at the base; however, the shape of the alveolus suggests the tooth was more circular at the alveolar border. The tooth appears to have been smaller than the canine.

The canine is also represented by the root. The tooth is single rooted and the base of the crown is slightly compressed anteroposteriorly resulting in an oval cross section. The size of the root indicates that the canine was larger than I₂ and P₂.

The premolars form a continuous series, with P₂ smaller than P₃, and P₃ smaller than P₄. They are

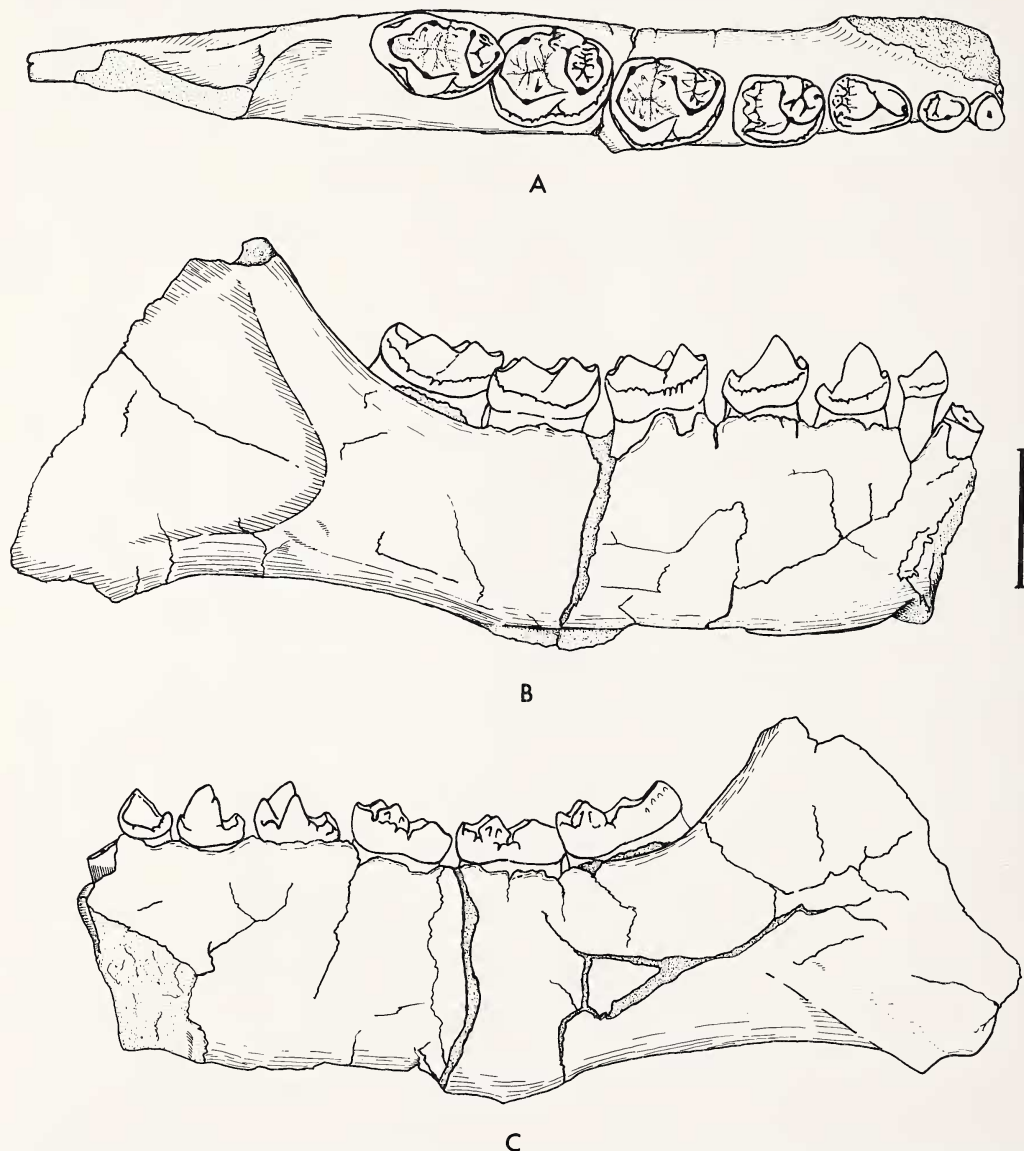


Figure 6. *Macrotarsius roederi* n. sp., holotype, partial right dentary with I₂ root, partial canine, and P₂-M₃, LACM 128928. A. Occlusal view. B. Lingual view. C. Labial view. Scale = 5 mm.

equally spaced and uncrowded. The enamel of the premolars becomes increasingly crenulated from P₂ (little crenulation) to P₄ (moderate crenulation).

The P₂ is single-rooted, slightly elongated antero-posteriorly, and expanded posteriorly. It is reduced in size relative to P₃ and P₄. The tooth lacks a paraconid and metaconid. A crista obliqua originates from the apex of the protoconid and terminates at a small distinct cusp at the posterolabial corner of the tooth. The posterior cingulum is slightly expanded, giving the tooth the general appearance of P₃ and P₄. The anterior, lingual, and posterior cingulae are prominent and continuous. The labial cingulum is moderately distinct.

The P₃ is two-rooted, elongated anteroposteriorly, and expanded posteriorly. A very small paraconid is present on the anterior cingulum. A slight bulge on the labial aspect of the protoconid suggests an incipient metaconid. The crista obliqua originates at the apex of the protoconid and terminates at a distinct cusp just lingual to the posterolabial corner of the tooth. The posterior cingulum is expanded and has several distinct cusps. The anterior, labial, and posterior cingulae are prominent and continuous. The P₃ is smaller but equal in height to P₄.

The P₄ is two-rooted and subquadrate in shape. The well-developed paraconid and metaconid form a distinct trigonid. The paraconid is positioned towards the lingual aspect of the tooth and is connected to the protoconid by a paralophid that is gently curved. The metaconid is connected to the protoconid by a protolophid that is almost straight, short, and notched apically. The cusps of the trigonid are unequal in height, with the paraconid the lowest, the protoconid the highest, and the metaconid intermediate. A small cusp is present at the anterolabial corner of the tooth between the paraconid and metaconid. The anterior, labial, and posterior cingulae are prominent and continuous. The crista obliqua originates at the apex of the protoconid and terminates at the posterior cingulum, near a small distinct cusp. This cusp, the largest of three present along the posterior cingulum, possesses a very small crest that is connected to the base of the posterior aspect of the protoconid.

The lower molars are characterized by a subquadrate to quadrate shape, metaconids and protoconids with accessory crests (cutting edges of Szalay and Delson, 1979), highly crenulated enamel, V-shaped trigonids, and expanded talonids.

The M₁ is subquadrate in shape. The trigonid is V-shaped with a low, gently curved paralophid with little apical relief and a relatively straight protolophid that is notched at the center. The paraconid is lower than the metaconid and protoconid, and a small accessory crest extends posteriorly from the paraconid towards the metaconid. The well-developed paraconid is positioned lingually. The metaconid is well developed, does not connect with the entoconid, and possesses two small accessory crests, one extending anteriorly towards the paraconid and

Table 2. Measurements (in mm) of teeth in holotype (LACM 128928) of *Macrotarsius roederi* n. sp. from the Brea Canyon Local Fauna.

	Dimension	Measurement
P ₂	A-P	1.85
	TR	1.55
P ₃	A-P	2.68
	TR	2.78
P ₄	A-P	3.43
	TR	2.96
M ₁	A-P	4.06
	TRI-TR	3.05
	TAL-TR	3.36
M ₂	A-P	4.17
	TRI-TR	3.24
	TAL-TR	3.35
M ₃	A-P	4.76
	TRI-TR	2.88
	TAL-TR	2.91

one extending posteriorly towards the entoconid. The crista obliqua is located labially where it originates at the base of the posterior aspect of the protoconid. The hypoconulid is not represented by a true cusp, and the position it would normally occupy is reduced to a notch in the postcristid. The talonid is expanded transversely. The anterior, labial, and posterior cingulae are prominent and continuous.

The M₂ is very similar to M₁, but it is more quadrate in shape because the trigonid is slightly more expanded, resulting in a longer protolophid. The paraconid is well developed and positioned lingually.

The M₃ is similar to M₁ and M₂, except that it possesses a robust hypoconulid.

DISCUSSION. *Macrotarsius* Clark, 1941, *Ourayia* Gazin, 1958, and *Mytonius* Robinson, 1968, represent a group of related omomyine primate genera whose taxonomy has been the subject of controversy (see Gazin, 1958; Simons, 1961; Robinson, 1968; Szalay, 1976; Krishtalka, 1978; Szalay and Delson, 1979). At times *Hemiacodon* Marsh, 1872, has also been included in this group; however, more recent revisions indicate it is not closely related to the other taxa (Krishtalka, 1978; Szalay, 1976). Szalay (1976) and Szalay and Delson (1979) do not recognize *Mytonius hopsoni* Robinson, 1968, or *Macrotarsius jepseni* Robinson, 1968, as valid taxa, but instead refer them to *Ourayia uintensis* (Osborn, 1895). Krishtalka (1978), however, considers *O. uintensis*, *M. hopsoni*, and *M. jepseni* as generically and specifically distinct taxa. Krishtalka (1978) provides convincing evidence that *M. hopsoni* is a valid taxon and that *M. jepseni* is not referable to *O. uintensis*. The comprehensive systematic revision presented by Krishtalka (1978) is followed here.

The presence of *Macrotarsius* along the Pacific Coast during the Eocene was first suggested by Lil-

legraven (1980) on the basis of three isolated lower molars recovered from the lower Uintan Friars and Mission Valley Formations in the San Diego area. The specimens were identified as ?*Macrotarsius* sp., near *M. jepseni*; however, the diagnostic lower premolars are unknown, and comparison with *Macrotarsius roederi* is difficult. It is not likely that these molars represent *M. roederi* because the M_3 in the San Diego sample is considerably smaller than the M_3 in *M. roederi*. Moreover, Mason (1988) identified the other two molars from the San Diego area as *Ourayia* instead of *Macrotarsius*.

Mason (1988, unpublished) described a new genus and species of omomyine primate from LACM(CIT) loc. 180 (Tapo Canyon Local Fauna). *Macrotarsius roederi* differs from this new taxon in having the following characters: teeth smaller; M_{1-3} metaconids not twinned; M_3 much less reduced relative to M_{1-2} ; M_3 hypoconulid positioned more labially.

Macrotarsius roederi is the most primitive member of the genus. *Macrotarsius siegerti* and *M. montanus* are more derived in their greater development of the accessory crests of the metaconids and paraconids and much greater reduction of the premolars relative to the molars. Based on similarities in the lower teeth, *M. roederi* appears to be most closely related to *M. jepseni*; however, *M. jepseni* is also more derived in having the following characters: premolars reduced relative to molars; P_3-M_3 crowded; P_{2-3} diastema present.

Order Artiodactyla

Family Oromerycidae Gazin, 1955

Genus *Protylopus* Wortman, 1898

Protylopus? sp.,
cf. *P.? robustus*
Golz, 1976
Figure 7

MATERIAL. LACM 128910, partial right dentary with M_3 .

LOCALITY. LACM 5627.

AGE AND FAUNA. Late Uintan, Brea Canyon Local Fauna.

DISCUSSION. The M_3 of LACM 128910 is similar to those of *Protylopus?* *robustus* but is larger ($A-P = 17.8$, $TR = 9.0$), is more robust, and has more complete labial and lingual cingulae. Additional material may demonstrate that the specimen is assignable to *P.? robustus*; however, at this time its distinctive characters warrant separation from *P.? robustus*. Golz (1976) referred two specimens (LACM 26365, 26366) from LACM(CIT) loc. 207 to *Protylopus?* sp., aff. *P.? robustus*. The M_3 of LACM 128910 is much larger than those of *P.?* sp., aff. *P.? robustus*.

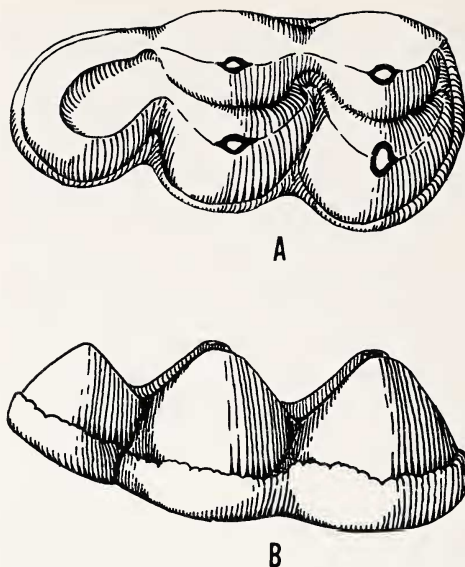


Figure 7. *Protylopus?* sp., cf. *P.? robustus* Golz, RM₃, LACM 128910. A. Occlusal view. B. Labial view. Scale = 5 mm.

Family Protoceratidae Marsh, 1891

Subfamily Leptotragulinae Zittel, 1893

Genus *Leptoreodon* Wortman, 1898

Leptoreodon pusillus Golz, 1976

Figure 8; Table 3

Leptoreodon pusillus Golz, 1976:62–65, figs. 36–38.

MATERIAL. LACM 128904, RM₂, LM₃.

LOCALITY. LACM 5620.

AGE AND FAUNA. Late Uintan, Brea Canyon Local Fauna.

DISCUSSION. The two lower molars of *Leptoreodon* from Simi Valley are intermediate in size between *L. pusillus* Golz, 1976, and *L. edwardsi* Stock, 1936a; however, morphologically, they appear to be very similar to those of *L. pusillus*. The lingual indentations between the metaconids and entoconids of the lower molars are slightly deeper than those in *L. edwardsi*, but are similar in depth to those in *L. pusillus*. The postfossettid of M_3 is open to the hypoconulid fossettid. The lingual ends of the posterior crests of the hypoconids are not lobate, as in *L. edwardsi*, but are less developed, as in *L. pusillus*. The Brea Canyon molars differ from those in the holotype of *L. pusillus* in having slightly more robust anterior and posterior cingulae, and from all other species of *Leptoreodon* (*L. edwardsi*; *L. leptolophus* Golz, 1976; *L. major* Golz, 1976; *L. marshi* Wortman, 1898; *L. stocki* n. sp.) by their smaller size.

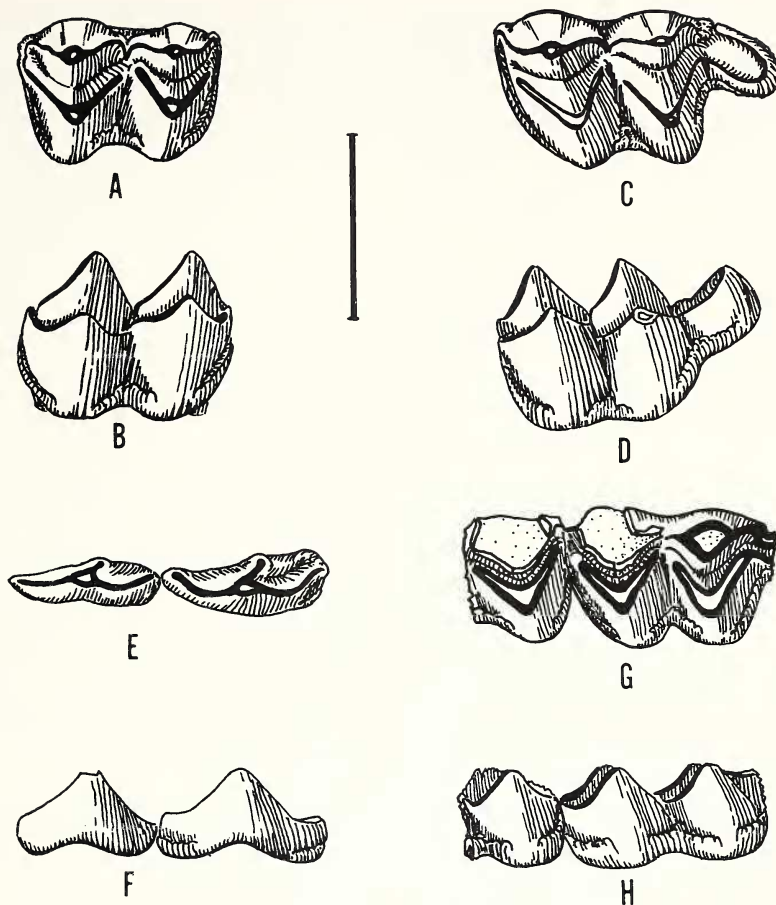


Figure 8. *Leptoreodon pusillus* Golz (A–D), and *L. sp.*, cf. *L. pusillus* (E–H). *Leptoreodon pusillus*, RM₂, LACM 128904. A. Occlusal view. B. Labial view; LM₃, LACM 128904. C. Occlusal view. D. Labial view. *Leptoreodon sp.*, cf. *L. pusillus*, RP₃₋₄, LACM 42401. E. Occlusal view. F. Labial view; partial M₂₋₃, LACM 42401. G. Occlusal view. H. Labial view. Scale = 5 mm.

The size range of the lower molars in *L. pusillus* is unknown because only the holotype (UCR 14005) from the Laguna Riviera Local Fauna in California (Golz, 1976), and three lower molar fragments from Texas (Wilson, 1986) were previously assigned to the species. The lower molars of *L. pusillus* from Brea Canyon are only slightly larger than those in the holotype (Table 3).

The presence of *L. pusillus* in the Brea Canyon and Laguna Riviera Local Faunas, and the Whistler Squat and Serendipity Local Faunas of Texas (Wilson, 1986), suggests this species was widespread in the southern United States during the middle Eocene.

Leptoreodon sp.,
cf. *L. pusillus*
Golz, 1976
Figure 8

MATERIAL. LACM 42401, partial left dentary with P₃₋₄, partial M₂ and M₃.

LOCALITY. LACM(CIT) 128.

AGE AND FAUNA. Latest Uintan or earliest Duchesnean, Strathern Local Fauna.

DISCUSSION. D.J. Golz, during his curatorship of the CIT Sespe Formation collection at the LACM, made a notation on the back of the specimen label for LACM 42401 questioning the recovery of this specimen from LACM(CIT) loc. 128; however, the

Table 3. Measurements (in mm) of teeth of *Leptoreodon pusillus* Golz (1976) from the Brea Canyon Local Fauna and holotype (UCR 14005) from the Laguna Riviera Local Fauna.

Dimension	LACM 128904		UCR 14005
	Right	Left	
M ₂ A–P	6.0		5.3
TR	4.4		4.1
M ₃ A–P		8.9	8.2
TR		4.4	4.8

original CIT label suggests that it was associated with other specimens that were definitely collected at LACM(CIT) loc. 128.

The premolars of LACM 42401 are very similar in size and morphology to those in the holotype of *L. pusillus* (UCR 14005). Dimensions of the teeth in the holotype are A-P = 4.6, TR = 1.8 for P₃, and A-P = 4.9, TR = 2.5 for P₄; those for the Brea Canyon specimen are A-P = 4.8, TR = 1.95 for P₃, and A-P = 4.9, TR = 2.8 for P₄. The only notable difference between the holotype of *L. pusillus* and the Brea Canyon specimen is the development of a small swelling on the posterolabial crest of P₃ in the Brea Canyon specimen, suggesting an incipient metaconid. However, this difference may not be taxonomically significant because Golz (1976) reported the presence or absence of a metaconid on P₃ is variable in large samples of *L. edwardsi*.

The hypoconid on the P₄ of the Brea Canyon specimen is weakly developed, as in *L. pusillus*, and differs from *L. edwardsi*, *L. leptolophus*, and *L. stocki* n. sp., in which a well-developed hypoconid is present. The entoconid is weakly developed, as in *L. pusillus*. The metaconid is prominent, as in *L. pusillus* and *L. edwardsi*, but not elliptical, as in *L. leptolophus* and *L. stocki*. A distinct paraconid is present and closely associated with the protoconid, as in *L. pusillus*, but differs from *L. edwardsi*, in which the paraconid is larger and more widely separated from the protoconid. The Brea Canyon premolars differ from those of all other species of *Leptoreodon* (*L. edwardsi*, *L. leptolophus*, *L. major*, *L. marshi*, *L. stocki* n. sp.) by their smaller size.

The partial lower molars from Simi Valley cannot be distinguished from those in the holotype of *L. pusillus*. The postfossettid of M₃ is open to the hypoconulid fossettid, and a worn accessory cuspid, which appears to be similar to the simple accessory cuspid in *L. pusillus*, is present.

The specimen from LACM(CIT) loc. 128 is assigned to *Leptoreodon* sp., cf. *L. pusillus*, because of the presence of the small metaconid on P₃; however, additional material may demonstrate that the presence of this character varies intraspecifically, as in *L. edwardsi* (Golz, 1976), and the Brea Canyon specimen could then be assigned to *L. pusillus*.

Leptoreodon stocki new species

Figures 9, 10; Tables 4-7

Leptoreodon sp., aff. *L. leptolophus* Golz, 1976:71-73, figs. 44, 45.

HOLOTYPE: LACM 26368, partial left dentary with P₄-M₃.

TYPE LOCALITY: LACM(CIT) 202.

HYPODIGM. LACM 26367, partial left maxilla with partial P⁴ and M¹⁻³; LACM 128907, partial left maxilla with C, P³-M³, partial left dentary with P₁-M₃, and partial right dentary with P₁-M₃; LACM

27389, RP⁴; LACM 52206, LP⁴; LACM 128908, RM²⁻³; LACM 128890, RM³; LACM 128889, LM³; LACM 128903, RM¹; LACM 128909, partial left dentary with P₂₋₄; LACM 27390, partial right dentary with P₂₋₄; LACM 27391, partial left dentary with M₃; LACM(CIT) 1948, partial left dentary with P₃-M₃; LACM 27392, partial right dentary with P₄-M₃; LACM 27393, partial right dentary with partial M₂ and M₃; LACM 27394, partial left dentary with P₄-M₃; LACM 128912, RP⁴; LACM 27395, partial right dentary with partial P₂₋₃, P₄, and M₂; LACM 27396, partial right dentary with M₃; LACM 128896, partial left dentary with M₁₋₂; LACM 128913, partial right dentary with M₁₋₂; LACM 128891, LM¹; LACM(CIT) 477, partial left dentary with M₁₋₂ and partial M₃; LACM 42403, partial LM¹; LACM 52207, partial left dentary with M₁; LACM 52208, partial right dentary with partial M₂ and M₃; LACM 42402, partial RM₃; LACM 128911, partial left dentary with partial M₃.

AGES, FAUNAS, AND DISTRIBUTION. Late Uintan, Tapo Canyon Local Fauna: LACM loc. 5621. Late Uintan, Brea Canyon Local Fauna: LACM(CIT) locs. 127, 151, 202, 207; LACM locs. 5618, 5625, 5628, 5631. Latest Uintan or earliest Duchesnean, Strathern Local Fauna: LACM(CIT) loc. 128. Early Duchesnean, Pearson Ranch Local Fauna: LACM(CIT) loc. 146; LACM locs. 5611, 5646, 5648.

ETYMOLOGY. Named in honor of the late Chester Stock. Stock, while at the CIT, was the first researcher to conduct extensive vertebrate paleontologic investigations in the Simi Valley area and the first to recognize the presence of Eocene land mammal assemblages in the Sespe Formation.

DIAGNOSIS. Larger than *L. pusillus*, *L. edwardsi*, and *L. leptolophus*; about equal in size to *L. marshi*; smaller than *L. major*. Differs from *L. pusillus*, *L. edwardsi*, *L. major*, and *L. marshi* in having the following characters: teeth with slightly stronger and more slender crests; molar mesostyles and metastyles more sharply flexed; P₄ paraconid and metaconid less bulbous; molar parastylids more sharply flexed; M₃ hypoconulid relatively more slender and anteroposteriorly elongated; accessory cuspid of the M₃ hypoconulid moderately to well developed, posterolingually directed, and crescent-shaped. Differs from *L. leptolophus* in having the following characters: teeth 5 to 19 percent larger; P³ anterolabial cingulum more prominent, labial indentation deeper, metastyle and parastyle more prominent, and incipient protocone more posteriorly positioned; P⁴ metastyle and parastyle slightly more prominent and labial indentation more prominent; upper molar cingulae more prominent with greater development of double anterior cingulae; P₄ wider, less reduced relative to M₁, and paraconid and metaconid slightly more robust; molars relatively wider and more robust cingulae.

DESCRIPTION. A single canine tooth (LACM 128907) is known. This tooth is relatively robust and roughly triangular in cross section. The anterior

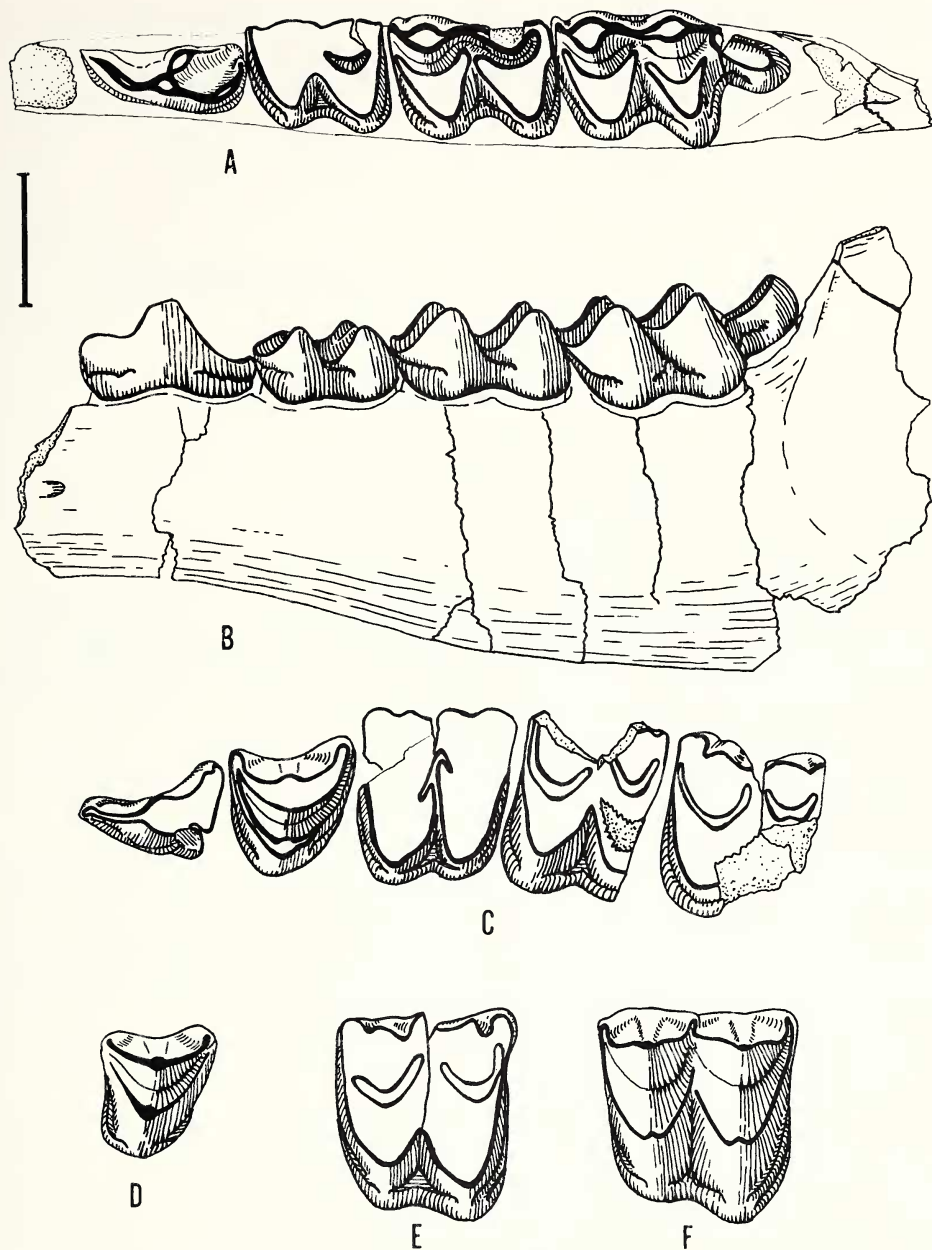


Figure 9. *Leptoreodon stocki* n. sp., holotype, partial left dentary with P_4 - M_3 , LACM 26368. A. Occlusal view. B. Labial view; LP^3 - M^3 , LACM 128907. C. Occlusal view; LP^4 , LACM 52206. D. Occlusal view; RM^3 , LACM 128908. E. Occlusal view; RM^3 , LACM 128890. F. Occlusal view. Scale = 5 mm.

apex is rounded and the posterior margin relatively flat. The enamel extends much farther on the labial surface than on the lingual surface. A well-developed rib is present on the lingual surface, and a moderately deep groove on the labial surface.

The P^3 is represented by one moderately worn specimen, LACM 128907. The tooth is three-rooted and elongated anteroposteriorly and has a distinct labial bulge suggestive of an incipient protocone. The paracone is centered somewhat lingually,

resulting in a central indentation of the labial wall of the tooth. Moderately curved crests extend from the paracone to the metastyle and parastyle. The anterolingual cingulum is very prominent, and the posterior cingulum is moderately prominent.

The P^4 is triangular in occlusal outline and somewhat transversely expanded. The metastyle and parastyle are well developed, and the crests that extend from the paracone to the parastyle and metastyle are sharply curved. The protocone is cres-

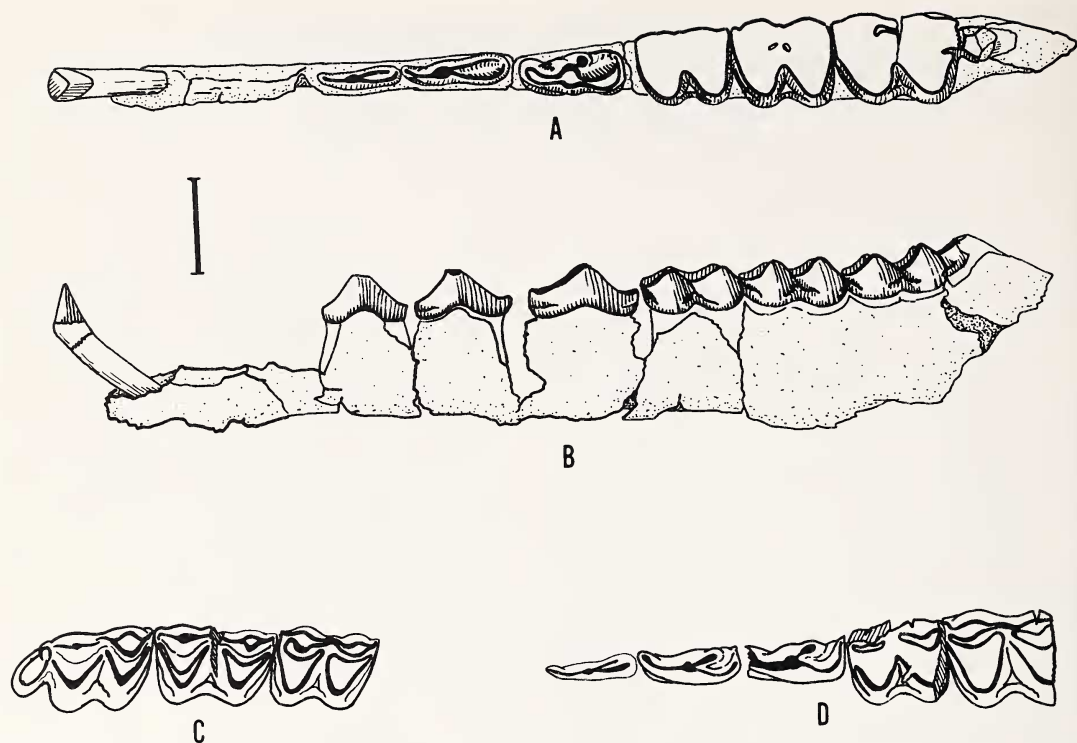


Figure 10. *Leptoreodon stocki* n. sp., LP₁-M₃, LACM 128907. A. Occlusal view. B. Labial view; RM₁₋₃, LACM 128913. C. Occlusal view; LP₂-partial M₂, LACM 128905. D. Occlusal view. Scale = 5 mm.

centic and the posterior crest of the protocone extends toward, but does not connect with, the posterolingual margin of the metastyle. The anterior and posterior cingulae are moderately prominent.

The upper molars have sharply compressed styles and slender crests. The lingual cingulum is moderately prominent and in some specimens (LACM 128907, 128908) is continuous across the base of the protocone and metaconule. The anterior cin-

gulum is well developed, and in some specimens a double anterior cingulum is present (Fig. 9F).

The P₁ is caniniform and represented by three specimens showing well-worn, anteriorly directed facets. A diastema approximately 8 mm long is present between P₁ and P₂.

The P₂ is a simple, elongated, single-cusped tooth. The anterolabial and posterolabial crests are gently

Table 4. Measurements (in mm) of upper teeth of *Leptoreodon stocki* n. sp. from Simi Valley. (N = sample size; OR = observed range; $\bar{X}$ = mean; SD = standard deviation; CV = coefficient of variation.)

Dimension	N	OR	$\bar{X}$	SD	CV
C					
A-P	1	4.2	—	—	—
TR	1	3.8	—	—	—
P ³					
A-P	1	7.2	—	—	—
TR	1	4.6	—	—	—
P ⁴					
A-P	3	5.2-5.8	5.7	0.29	4.7
TR	3	6.0-6.2	6.15	0.20	3.4
M ¹					
A-P	2	7.0-7.1	7.05	0.07	1.0
TR	3	8.2-9.1	8.8	0.49	5.6
M ²					
A-P	2	7.5-7.9	7.7	0.28	3.6
TR	2	9.9	—	—	—
M ³					
A-P	4	8.2-8.4	8.3	0.09	1.1
TR	4	10.0-10.8	10.5	0.35	3.4

Table 5. Measurements (in mm) of lower teeth of *Leptoreodon stocki* n. sp. from Simi Valley. See Table 4 for key to abbreviations.

Dimension	N	OR	$\bar{X}$	SD	CV
P ₁					
A-P	2	4.3-4.4	4.35	0.07	1.6
TR	2	2.6-2.8	2.7	0.14	5.2
P ₂					
A-P	5	5.3-6.0	5.7	0.25	4.4
TR	3	2.0-2.2	2.1	0.14	6.6
P ₃					
A-P	5	5.7-6.8	6.3	0.37	5.9
TR	3	3.0-3.2	3.1	0.13	4.3
P ₄					
A-P	9	6.1-7.2	6.7	0.36	5.4
TR	10	3.2-4.3	3.7	0.33	9.0
M ₁					
A-P	12	6.0-7.2	6.6	0.40	6.0
TR	12	4.7-5.8	5.2	0.35	6.7
M ₂					
A-P	11	7.3-8.7	7.8	0.49	6.2
TR	13	5.6-6.3	6.0	0.26	4.4
M ₃					
A-P	10	10.8-11.8	11.3	0.40	3.5
TR	14	5.4-6.5	6.0	0.35	5.8

Table 6. Measurements (in mm) of upper teeth for specimens of *Leptoreodon stocki* n. sp. from Simi Valley.

Specimen number (LACM)	Dimension					
	C A-P:TR	P ³ A-P:TR	P ⁴ A-P:TR	M ¹ A-P:TR	M ² A-P:TR	M ³ A-P:TR
128907	4.2:3.8	7.2:4.6	5.8:6.2	—:8.2	—:9.4a*	—:—
128908					7.5:9.9	8.2:10.4
128890						8.4:10.8
128889						8.4:10.7
128903				7.0:9.1		
27389			5.7:6.4			
52206			5.3:6.0			
26367				7.1:8.8	7.9:9.9	8.4:10.0

* a = approximate.

curved lingually. The posterolingual crest is moderately developed.

The P₃ is elongated and slightly wider than P₂. The anterolabial and posterolabial crests are gently curved lingually. The paraconid is developed as a small distinct lingual bulge. The posterolingual crest is well developed, and the posterior basin may be open or closed posteriorly. The metaconid is slightly developed as a bulge on the posterolingual crest.

The P₄ is wider than P₂ and P₃ and slightly narrower than M₁. The anterolabial crest is gently curved lingually. A paraconid is present as a conical or oval bulge on the anterolabial crest. The hy-

poconid is weakly developed as a small bulge on the posterolabial crest. An incipient entoconid is present and ranges in shape from a very small bulge to a slightly larger conical bulge. The metaconid is generally a small conical bulge connected by a small crest to the posterolingual crest; however, in one specimen (LACM 128912), the metaconid is only a small swelling on the posterolingual crest. The anterolingual and posterior cingulae are variable, ranging from very weakly to moderately well developed.

The M₁₋₃ labial cusps are strongly crescentic and relatively flat in occlusal outline. The parastylids

Table 7. Measurements (in mm) of lower teeth for specimens of *Leptoreodon stocki* n. sp. from Brea Canyon area.

Specimen number (LACM)	Dimension						
	P ₁ A-P:TR	P ₂ A-P:TR	P ₃ A-P:TR	P ₄ A-P:TR	M ₁ A-P:TR	M ₂ A-P:TR	M ₃ A-P:TR
27389				6.8:3.8	6.4:5.4	8.0:6.2	
27390		6.0:—	6.3a:—				
27395		5.3:—	5.7:—	6.9:3.5a*			
26368				7.4:4.0	6.8:5.5	8.2:6.1a	11.7a:6.5
27392				6.3a:3.3	6.5:5.1	7.5:5.7	11.6a:5.8
27394				6.1:3.2	6.1:4.9	7.6:6.0	—:5.8
27393						—:6.3	11.3:5.8
27391							11.0:5.9
27396							11.8:6.5
42403					7.2:—		
52207					6.8:5.4		
52208						—:5.9	11.8:6.5
42402							—:6.3a
(CIT) 477							—:6.3a
128905		5.6:2.3	6.5:2.9	—:3.7	—:—	—:—	
128907	4.4:2.6	5.7:2.2	6.4:3.0	6.7:3.9	6.5:5.8	7.3:6.2	11.3:6.1
128907	4.3:2.9	5.7:2.0	6.8:3.0	7.2:3.8	6.3:5.6	7.5:5.7	11.2a:6.0
128896					7.2:5.1	8.5:5.9	
128909		5.7:2.2	6.3:3.2	—:4.3			
128912				6.5:3.8			
128911							—:5.8
128891					7.2:5.1		
128913					6.0:4.7	7.4:5.6	10.8:5.5

* a = approximate.

are small but distinct and sharply flexed. The termini of the posterior crest of the metaconid and the anterior crest of entoconid are separate and slightly overlap each other in unworn teeth; however, these crests connect with wear. The posterior crest of the entoconid is well developed and connected to the posterior crest of the hypoconid. A small cuspid is present between the protoconid and hypoconid on the lingual cingulum in unworn specimens. This cuspid disappears with wear. The anterior and posterior cingulae are very prominent. The hypoconulid of M_3 is long and narrow and is usually closed off lingually from the postfossettid by a crescent-shaped accessory cuspid. This cuspid varies in shape from a partial crescent to an almost complete circle.

DISCUSSION. Golz (1976) assigned specimens from LACM(CIT) locs. 202 and 207 (Brea Canyon Local Fauna) to *Leptoreodon* sp., aff. *L. leptolophus*, recognizing these specimens as different from those of the closely related *L. leptolophus* from the Laguna Riviera Local Fauna. With the discovery of additional material from Simi Valley, it is now possible to compare this sample with *L. leptolophus*.

Golz (1976) considered the distinct crescent-shaped accessory cuspid of the M_3 hypoconulid the most important character demonstrating *L. leptolophus* and the Simi Valley sample of *Leptoreodon* were related. This cuspid closes off the postfossettid from the hypoconulid fossettid in all specimens of *L. leptolophus*. Golz (1976) noted that a specimen (LACM 27391) from LACM(CIT) loc. 207 in Simi Valley exhibited only partial closure of the M_3 hypoconulid fossettid, whereas a specimen (LACM 27393) from higher in the section at LACM(CIT) loc. 202 approaches the more closed condition of the fossettid, as in *L. leptolophus*. Another specimen (LACM 27396) from LACM(CIT) loc. 202 has a broken accessory cuspid, although the lingual wall shows complete closure of the fossettid. A series of relatively unworn M_3 's is now available that spans the stratigraphic interval from the level of LACM(CIT) loc. 207 (upper Uintan) to that of LACM loc. 5648 (Duchesnean). Golz (1976) suggested the degree of closure of the M_3 hypoconulid fossettid increased with decreasing geologic age, and this suggestion is supported by the new material discovered during the present study. The accessory cuspid in earlier specimens [from the level of LACM(CIT) loc. 207] develops posteriorly as a partial crescent extending from the entostylid, in later samples [from the levels of LACM(CIT) locs. 127 and 202] extends labially as a complete crescent closing off the postfossettid from the hypoconulid fossettid, and in the latest sample (from the level of LACM loc. 5648) forms an almost complete circle. The variation seen in the accessory cuspid suggests a morphocline extending from a more primitive (open hypoconulid, less complex accessory cuspid) to a more derived state (closed hypoconulid, complex accessory cuspid) through time.

The development of double anterior cingulae on the M^{1-3} may also represent a morphocline. The M^{2-3} (LACM 128908) from the level of LACM(CIT) loc. 151 (upper Uintan) exhibits moderately developed double anterior cingulae, whereas M^3 's (LACM 128889, 128890) from LACM(CIT) loc. 128 (uppermost Uintan or lowest Duchesnean) exhibit well-developed double anterior cingulae. Although the sample of *L. stocki* upper molars is small, it appears that the presence of a double anterior cingulum is an advanced character, which reaches its greatest development in specimens from higher stratigraphic levels.

All specimens referred to *L. leptolophus* by Golz (1976) are from one locality (UCR loc. RV-6830 = UCMP loc. V-6839, LACM loc. 68102) and represent a single population. The following alternative interpretations of the observed variation in *Leptoreodon* arose during the present study: 1) the specimens from Simi Valley are a single species representing a temporal morphocline; or 2) more than one species exists; 3) the Simi Valley samples belong to *L. leptolophus*, which exhibits a wide range of intraspecific variation; or 4) the Simi Valley samples represent a distinct species. The morphologic characters that Golz (1976) used to separate the Simi Valley specimens from *L. leptolophus* and additional diagnostic characters based on the new material seem to corroborate his recognition of the Simi Valley samples as a distinct species.

To test the assumption that the Simi Valley samples represent a distinct species, a series of statistical analyses were performed to measure the degree of variability in the Simi Valley samples of *L. stocki* and to compare the Simi Valley samples with the topotypic sample of *L. leptolophus*. In addition, the specimens from Texas identified as *L. leptolophus* by Wilson (1984) were compared with the topotypic sample of *L. leptolophus* to help clarify the extent of geographic variation between these samples of *Leptoreodon*. The samples were first divided into three groups: group 1 represented all late Uintan specimens from Simi Valley; group 2 represented all Duchesnean specimens from Simi Valley; and group 3 represented the topotypic specimens of *L. leptolophus* from the Laguna Riviera Local Fauna.

The coefficient of variation (CV) is a good measure of relative dispersion within a population, and most species exhibit CV's of about five or six for linear measurements (Simpson *et al.*, 1960). Table 8 presents the CV's calculated for each group and various combinations of the groups. In addition, the CV's calculated by Golz (1976) for *L. edwardsi*, a well-defined species of *Leptoreodon*, were included to allow comparison of these CV's with those of the Simi Valley samples of *L. stocki*. In Table 9, a summary of the distribution of CV's greater than seven for each grouping in Table 8 indicates groups 1 and 1+2 exhibit a comparatively low degree of dispersion that is consistent with that for a single species; however, when grouped with

Table 8. Coefficients of variation (CV) for groups of samples of *Leptoreodon* (group 1 = Uintan specimens of *L. stocki* n. sp. from Simi Valley; group 2 = Duchesnean specimens of *L. stocki* from Simi Valley; group 3 = *L. leptolophus* Golz (1976) from Laguna Riviera Local Fauna). CV's calculated by Golz (1976) for large sample of *L. edwardsi* from Dry Canyon are included for comparison. See Table 4 for key to abbreviations.

		Group											
		1		1+2		3		1+3		1+2+3		<i>L. edwardsi</i>	
Dimension		N	CV	N	CV	N	CV	N	CV	N	CV	N	CV
P ⁴	A-P	3	4.7	3	4.7*	6	2.7	9	6.0	9	6.0	10	8.1
	TR	3	3.4	3	3.4*	6	4.5	9	4.1	9	4.1	10	4.7
M ¹	A-P	2	1.0	2	1.0*	13	4.8	15	5.8	15	5.8	10	3.6
	TR	3	5.6	3	5.6*	12	2.6	15	7.7	15	7.7	10	4.3
M ²	A-P	2	3.6	2	3.6*	15	3.4	17	4.4	17	4.4	10	6.3
	TR	2	0	2	0*	15	3.8	17	6.3	17	6.3	10	5.6
M ³	A-P	2	1.7	4	0.1	12	5.3	14	7.7	16	7.7	10	4.3
	TR	2	0	4	3.4	12	5.9	14	8.1	16	10.1	10	4.3
P ₃	A-P	5	4.4	5	5.9*	5	2.1	10	4.7	10	4.7	10	3.2
	TR	3	6.6	3	4.3*	5	16.2	8	18.6	8	18.6	10	8.5
P ₄	A-P	9	5.4	9	5.4*	4	2.7	13	5.8	13	5.8	20	4.4
	TR	10	9.0	10	9.0*	4	0.05	14	9.7	14	9.7	20	5.0
M ₁	A-P	7	3.9	12	6.0	14	4.1	21	3.9	26	5.3	20	4.4
	TR	7	5.6	12	6.7	14	12.0	21	12.8	26	11.7	20	6.2
M ₂	A-P	7	6.3	11	6.2	10	4.8	17	6.3	21	7.0	20	3.8
	TR	9	3.9	13	4.4	10	9.6	21	11.1	24	10.5	20	4.7
M ₃	A-P	8	2.4	10	3.5	5	2.7	13	4.1	15	4.1	20	2.5
	TR	12	4.8	14	5.8	5	13.2	14	11.5	19	10.7	20	5.5

* Indicates no Duchesnean specimens were present in sample.

the sample of *L. leptolophus* from the Laguna Riviera Local Fauna, a high degree of variation is apparent and suggests a degree of heterogeneity sufficient to recognize the Simi Valley samples as a distinct species.

To further test the degree of heterogeneity between *L. leptolophus* and the Simi Valley samples of *L. stocki*, Student's t-tests were performed using the linear dimensions of M₁ and M₂. These teeth were selected because they are relatively evenly distributed between groups and represent the largest number of measurable specimens. The null hypothesis was that the Laguna Riviera sample (group 3) and the Simi Valley samples (groups 1 and 1+2) were not significantly different and represent the same species. The calculations resulted in rejection of the null hypothesis and indicate a significant difference exists between the Simi Valley and the Laguna Riviera samples (Table 10). To further test if *L. leptolophus* and *L. stocki* represent distinct species, Student's t-tests comparing a single specimen to a sample were performed. The holotype of *L. leptolophus* (UCR 13499) was compared with the Simi Valley groups 1 and 1+2. Conversely, the holotype of *L. stocki* (LACM 26368) was compared with the Laguna Riviera sample (group 3). The null hypothesis was that the holotypes do not differ statistically from the other species sample. The calculations led to rejection of the null hypothesis and

indicate that each holotype is significantly different from the other species sample (Table 11). To determine the probability that either combination of groups represents the normal distribution expected for a single species, a Goodness-of-Fit test was performed using the width of M₁ for groups 1+2 and 1+2+3 (Table 12). The null hypothesis that groups 1+2 (late Uintan and Duchesnean, Simi Valley) represent a single species was accepted. The null hypothesis that groups 1+2+3 represent a single species was rejected. In summary, all the statistical tests performed support recognition of *L. stocki* as a species distinct from *L. leptolophus*.

Only a few Duchesnean specimens of *L. stocki* are known. To determine if these specimens and

Table 9. Summary of coefficients of variation (CV) greater than seven for groups of samples of *Leptoreodon* presented in Table 8. See Table 4 for key to abbreviations.

CV	Group					<i>L. edwardsi</i>
	1	1+2	3	1+3	1+2+3	
>10	0	0	3	4	5	0
>9	0	0	4	5	6	0
>8	1	1	4	6	6	2
>7	1	1	4	7	8	2

Table 10. Results of Student's t-tests comparing sample of *Leptoreodon stocki* n. sp. (group 1 = Uintan specimens; group 1+2 = Uintan and Duchesnean specimens) from Simi Valley and sample of *L. leptolophus* (group 3) from Laguna Riviera Local Fauna. Null hypothesis is that samples of *L. stocki* and *L. leptolophus* do not differ significantly and represent same species. (D.F. = degrees of freedom; t = t-value calculated; P = probability.)

Samples compared	Dimension	D.F.	t	P	Null hyp.
1 and 3	M ₁ A-P	23	1.398	0.172	accepted
		18	3.831	0.002	rejected
	M ₂ A-P	15	2.390	0.029	rejected
		19	6.184	<0.001	rejected
(1+2) and 3	M ₁ A-P	20	1.254	0.222	accepted
		22	3.486	0.002	rejected
	M ₂ A-P	19	2.689	0.014	rejected
		22	6.107	<0.001	rejected

the late Uintan specimens belong to the same species, a series of Student's t-tests comparing a single specimen and a sample were performed. The null hypothesis was that each Duchesnean specimen [LACM(CIT) 477, LACM 128891, 128896, 128913] does not differ significantly from the late Uintan sample (group 1). The calculations resulted in acceptance of the null hypothesis, indicating the Duchesnean and Uintan samples from Simi Valley rep-

resent one species (Table 13). However, as seen in Table 13, one Duchesnean specimen (LACM 128913) exhibits relatively low probabilities (P) of belonging to *L. stocki*; nevertheless, all measurements met the 95% or greater level of confidence, and, thus, this specimen probably represents a small individual of *L. stocki*. It must be noted that the temporal range of *L. stocki* may be greater than one million years and it should not be unexpected to find a moderate degree of variability in this species through time.

Table 11. Results of Student's t-tests comparing single specimen and known sample. Holotype of *Leptoreodon leptolophus* (UCR 13499) compared with samples of *L. stocki* n. sp. from Simi Valley (group 1 = Uintan specimens; group 1+2 = Uintan and Duchesnean specimens) and holotype of *L. stocki* n. sp. (LACM 26368), compared with sample of *L. leptolophus* from Laguna Riviera Local Fauna (group 3). Null hypothesis is that each holotype does not differ significantly from other species sample. See Table 10 for key to abbreviations.

Samples compared	Dimension	D.F.	t	P	Null hyp.
UCR 13499 and 1	M ₁ A-P	6	1.230	0.26	accepted
		6	1.237	0.26	accepted
	M ₂ A-P	6	1.321	0.23	accepted
		8	3.632	0.01	rejected
	M ₃ A-P	7	1.670	0.14	accepted
		8	2.938	0.02	rejected
UCR 13499 and 1+2	M ₁ A-P	11	0.625	>0.50	accepted
		11	0.42	>0.70	accepted
	M ₂ A-P	10	1.815	0.10	accepted
		12	2.857	0.01	rejected
	M ₃ A-P	9	0.953	>0.30	accepted
		13	2.208	0.04	rejected
LACM 26368 and 3	M ₁ A-P	13	2.452	0.03	rejected
		13	0.778	>0.40	accepted
	M ₂ A-P	9	2.418	0.04	rejected
		9	2.825	0.02	rejected
	M ₃ A-P	4	3.126	0.04	rejected
		4	2.044	0.11	accepted

A series of Student's t-tests was performed to determine if the specimens from the Candelaria Local Fauna of Texas (TMM 40276-17, 40187-1) referred to *L. leptolophus* by Wilson (1984) represent members of the same species as does the topotypic sample. The calculations resulted in acceptance of the null hypothesis that the Texas specimens are representatives of *L. leptolophus* (Table 14) and confirm Wilson's (1984) premise that *L. leptolophus* was widespread in the southern United States during the middle Eocene.

In summary, *L. stocki* represents a distinct species of *Leptoreodon* that is present in the upper Uintan to lower Duchesnean of Simi Valley and is closely related to *L. leptolophus* of the Laguna Riviera Local Fauna.

Table 12. Results of Goodness-of-Fit tests on transverse width of M₁. Two groups were analyzed: 1+2 includes Uintan and Duchesnean specimens of *Leptoreodon stocki* n. sp. from Simi Valley; 1+2+3 includes Uintan and Duchesnean specimens of *L. stocki* from Simi Valley and specimens of *L. leptolophus* from Laguna Riviera Local Fauna. Null hypothesis is that samples do not differ significantly and each group represents a single species. See Table 10 for abbreviations.

Group	D.F.	Chi-square value	P	Null hyp.
1+2	3	2.073	0.5574	accepted
1+2+3	3	20.28	<0.005	rejected

Table 13. Results of Student's t-tests comparing single specimen to known sample. Each Duchesnean specimen of *Leptoreodon stocki* [LACM 128896, 128891, 128913, LACM(CIT) 477] compared with Uintan sample of *L. stocki* (group 1). Null hypothesis is that each Duchesnean specimen does not differ significantly from Uintan sample and represents same species. See Table 10 for key to abbreviations.

Samples compared	Dimension	D.F.	t	P	Null hyp.
LACM 128896 and 1	M ₁ A-P	6	2.062	0.08	accepted
	TR	6	0.928	>0.60	accepted
	M ₂ A-P	6	1.227	0.28	accepted
	TR	8	0.404	>0.70	accepted
LACM 128891 and 1	M ₁ A-P	6	2.062	0.07	accepted
	TR	6	0.928	>0.60	accepted
LACM 128913 and 1	M ₁ A-P	6	1.663	0.09	accepted
	TR	6	2.165	0.07	accepted
	M ₂ A-P	6	0.755	>0.40	accepted
	TR	8	1.614	0.14	accepted
	M ₃ A-P	7	2.039	0.08	accepted
	TR	8	1.632	0.14	accepted
LACM(CIT) 477 and 1	M ₁ A-P	6	0.898	0.40	accepted
	TR	6	1.237	0.26	accepted
	M ₂ A-P	6	0.661	>0.40	accepted
	TR	8	0.807	>0.40	accepted
	M ₃ A-P	—	—	—	—
	TR	8	0.653	>0.40	accepted

Order Rodentia

Family Ischyromyidae
Alston, 1876

Genus *Rapamys* Wilson, 1940a

Rapamys sp. indet.
Figure 11

MATERIAL. LACM 128929, worn RM₂?.
LOCALITY. LACM 5645.

AGE AND FAUNA. Early Duchesnean, Pearson Ranch Local Fauna.

DISCUSSION. The lower molar is so worn that only generic assignment to *Rapamys* can be made. *Rapamys* has not been recorded previously in the Duchesnean of Simi Valley, although *Rapamys*

fricki Wilson, 1940a, and *Rapamys* sp. A (Wood, 1962) have been recorded from lower in the Brea Canyon section at LACM(CIT) locs. 202 and 207. *Rapamys* sp. indet. is slightly larger than *Rapamys* sp. A and *R. fricki*.

Subfamily Ailuravinae
Michaux, 1968

Genus *Mytonomys*
Wood, 1956

Mytonomys burkei
(Wilson, 1940a)
Figure 12; Table 15

Leptotomus burkei Wilson, 1940a:73–74, pl. 2, figs. 1, 1a.

Table 14. Results of Student's t-tests comparing single specimen and known sample. Specimens of *Leptoreodon leptolophus* from Texas (TMM 40276-17, 40187-1) compared with known sample of *L. leptolophus* (group 3) from Laguna Riviera Local Fauna. Null hypothesis is that each specimen from Texas does not differ significantly from known sample and represents the same species. See Table 10 for key abbreviations.

Samples compared	Dimension	D.F.	t	P	Null hyp.
TMM 40276-17 and 3	M ₁ A-P	13	0.372	>0.70	accepted
	TR	13	1.073	0.30	accepted
	M ₂ A-P	9	0.545	0.40	accepted
	TR	9	1.751	0.11	accepted
TMM 40187-1 and 3	M ₁ A-P	13	1.486	0.16	accepted
	TR	13	1.252	0.23	accepted
	M ₂ A-P	9	0	>0.99	accepted
	TR	9	0	>0.99	accepted

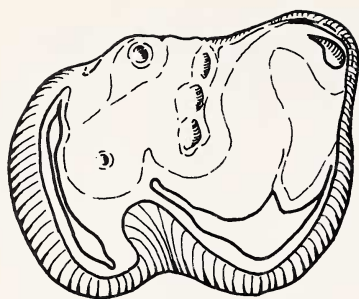


Figure 11. *Rapamys* sp. indet., worn LM₃?, LACM 128929; occlusal view. Scale = 1 mm.

Mytonomys burkei (Wilson): Wood, 1956:753.
Leptotomus sp., near *L. burkei* Wilson, 1940a, in part: Wood, 1962:229–231, fig. 84G, H.
Mytonomys burkei (Wilson): Korth, 1984:47; Korth, 1988:290.

MATERIAL. LACM 128931, partial lower incisor, LM², LM₂?, and RM₂?, LACM 128930, partial right dentary with incisor root and P₄–M₁.

LOCALITIES. LACM 5625, 5626.

AGE AND FAUNA. Late Uintan, Brea Canyon Local Fauna.

DESCRIPTION. In cross section, the lower incisor of LACM 128931 is widened anteriorly, with a gently curved anterior face and a slightly flattened medial surface. The posterior portion of the tooth narrows to an irregular elongated crescent. The pulp cavity is an elongated oval. The anterior enamel band extends posteriorly well onto the lateral surface of the tooth, whereas it barely extends onto the medial surface. A very slight indication of grooving of the enamel is present, but the grooving does not result in any indentation of the enamel in cross section.

The well worn M²? of LACM 128931 is very similar to an upper molar [LACM(CIT) 2178] tentatively referred to *Mytonomys burkei* by Wood (1962). A deep notch is present between the protocone and hypocone, accentuating the hypocone. The protocone is prominent, expanded labially, and a moderate notch is present anterior to the protocone. The anterior cingulum, although worn, is well developed and terminates at the labial margin of the parastyle. The mesostyle is large and appar-

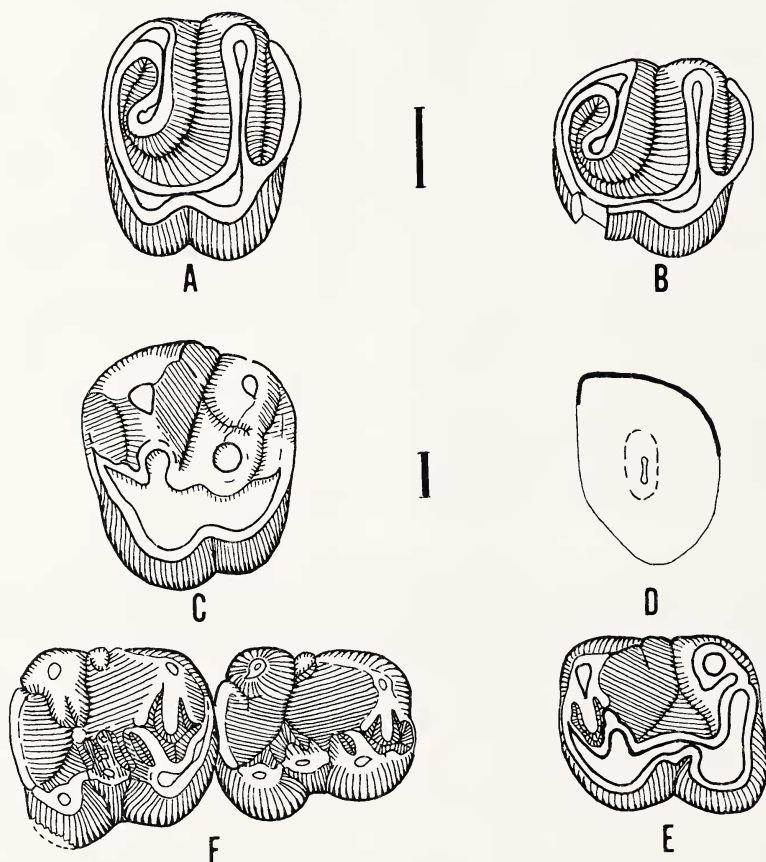


Figure 12. *Pareumys* sp., aff. *P. milleri* Peterson (A, B) and *Mytonomys burkei* Wilson (C–F). *Pareumys* sp., aff. *P. milleri*, RM², LACM 128892. A. Occlusal view; RM¹, LACM 128892. B. Occlusal view. Upper scale for A and B = 1 mm. *Mytonomys burkei*, LM², LACM 128931. C. Occlusal view; RI₁, LACM 128931. D. Cross section; LM₂?, LACM 128931. E. Occlusal view; RP₄–M₁, LACM 128930. F. Occlusal view. Lower scale for C–E = 1 mm.

ently lacks an accessory loph directed towards the metaconule. The protoconule and metaconule are distinct, the latter being much larger. The curvature of the labial cusps is moderately convex. The enamel in the valleys was probably moderately crenulated because a small area just anterior to the protoconule, though very worn, still shows evidence of crenulation.

The slightly worn P₄ of LACM 128930 is unreduced and longer than the associated M₁. A well-developed accessory ridge extends from the metaconid into the trigonid between the anterolophid and metalophid. The metalophid (= protolophid of Wood, 1962) is almost complete and nearly closes off the trigonid posteriorly. The metaconid and protoconid are not widely separated, resulting in a relatively short metalophid. A distinct mesostylid and mesoconid are present. An entoconid crest is not present. The posterolophid is prominent, and a small cleft is present between the posterolophid and entoconid. The entoconid is elevated well above the posterolophid. The enamel is moderately crenulated.

The lower molars of LACM 128931, even in their worn state, have the accessory ridge of the metaconid and a remnant of the entoconid crest. The slightly worn M₁ of LACM 128930 is very similar in morphology to the specimens of *M. burkei* described by Wood (1962), except the entoconid and mesoconid crests are slightly less prominent. The posterolophid of LACM 128930 is prominent, and a small cleft is present between the posterolophid and entoconid.

DISCUSSION. *Mytonomys burkei* was originally described as *Leptotomus burkei* by Wilson (1940a). Wood (1956) proposed *Mytonomys*, typified by *M. robustus* (Peterson, 1919), and assigned specimens of *L. burkei* to the genus. Wood (1962) described material assigned to *M. burkei* and referred specimens originally identified as *Leptotomus* sp., near *L. burkei* by Wilson (1940a), to the species. Wood (1956, 1962) referred *Mytonomys* to the subfamily Prosciurinae, based on a number of diagnostic characters. Black (1968) discussed each character and refuted this assignment, concluding that *Mytonomys* is an ischyromyid, with no close relationship to the prosciurines. Wood (1976) tentatively included *Mytonomys* in the Ailuravinae, and Korth (1988) provided further evidence *Mytonomys* belongs in this subfamily. Korth (1984, 1988) reevaluated *Mytonomys* and referred *Pseudotomus coloradensis* (Wood, 1962) and *Leptotomus mytonensis* (Wood, 1962) to the genus, and synonymized *Leptotomus kayi* (Burke, 1934) with *M. robustus* (Peterson, 1919).

Only six specimens from the Sespe Formation have previously been referred to *Mytonomys burkei*, three from LACM(CIT) loc. 202 and three from LACM(CIT) loc. 207 (Wilson, 1940a; Wood, 1956, 1962; Mason, 1988). All of this material is fragmentary. Previously, the lower incisor was unknown and only an isolated upper molar

Table 15. Measurements (in mm) of the teeth of *Mytonomys burkei* from Simi Valley.

Dimension	LACM 128931		LACM 128930
	Right	Left	
M ² A-P	5.96		
TR	4.91		
I A-P		5.15	
TR		3.85	
P ₄ A-P			5.55
ANT-TR			4.42
POST-TR			5.45
M ₁ A-P			5.45
ANT-TR			4.86
POST-TR			5.15a*
M ₂ A-P	5.19	5.20	
ANT-TR	4.50	4.55	
POST-TR	—	4.94	

* a = approximate.

[LACM(CIT) 2178] was referred to this species with uncertainty. This upper molar was illustrated by Wilson (1940a, pl. 2) and briefly described by Wood (1962). With the discovery of an upper molar [LACM(CIT) 128931] associated with lower teeth definitely referable to *M. burkei*, LACM(CIT) 2178 can now be confidently assigned to the species. Wood (1962) only cursorily described the previously known specimens of P₄ [LACM(CIT) 2174, 2176] of *M. burkei* because they are badly worn.

The specimens (LACM 128930, 128931) described herein can be confidently referred to *Mytonomys* because the lower molars possess the diagnostic accessory ridge that extends from the metaconid into the trigonid between the anterolophid and metalophid (Wilson, 1940a; Wood, 1962; Black, 1968). These specimens are indistinguishable from those of *M. burkei* described by Wilson (1940a) and Wood (1962), except for the entoconid and mesoconid crests of the M₁ in LACM(CIT) 128930, which are not as prominent. Black (1968) found the development of the entoconid crest in *Mytonomys robustus* to be variable. The differences are minor and herein regarded as intraspecific variation.

The new specimens of *M. burkei* from the Sespe Formation described herein provide the following additional characters that distinguish *M. burkei* from *M. robustus*: mesostyle of upper molars lacking accessory loph directed toward metaconule; slightly less anterior notching of protocone; labial curvature of upper molar cusps slightly less convex; P₄ metaconid and protoconid not as widely separated; P₄ entoconid crest absent. These specimens also provide the following additional characters that distinguish *M. burkei* from *M. mytonensis*: larger; parastylar area of upper molar more expanded; P₄ larger than M₁; accessory lophs of lower cheek teeth better developed.

Family Cylindrodontidae
Miller and Gidley, 1918

Genus *Pareumys*
Peterson, 1919

Pareumys sp.,
aff. *P. milleri*
Peterson, 1919

Figure 12

Pareumys sp., near *P. milleri* Peterson. Wilson, 1940c:99–101, pl. 1, figs. 1, 2, 6; pl. 2, fig. 1, 1a.
Pareumys sp., in part, Wilson, 1940c:102–103, pl. 1, fig. 3.

MATERIAL. LACM 128892, RM¹⁻².

LOCALITY. LACM 3549.

AGE AND FAUNA. Late Uintan to early Duchesnean, Brea Canyon and Pearson Ranch Local Faunas.

DESCRIPTION. The M¹⁻² of LACM 128892 have similarly structured lophs and are almost flat-topped [lophs about same height, except the anterior cingulum (= anteroloph), which is lower]. The protoloph is continuous from the protocone to the paracone. The metaloph bends posteriorly toward the posterior cingulum (= ectoloph), its base uniting with the cingulum and forming a small cleft on the occlusal surface between the protocone and cingulum. The posterior cingulum is prominent and continuous from the hypocone to metacone. A well-developed groove is present on the M¹ between the protocone and hypocone and accentuates a large distinct hypocone. A similar, but less prominent, groove is present on the M² between the protocone and hypocone. A portion of the posterolabial wall of the M² hypocone is missing; however, this cusp apparently was moderately distinct. The dimensions of LACM 128892 are A-P = 1.77, anterior TR = 1.92 for M¹, and A-P = 2.09, anterior TR = 2.42, posterior TR = 2.35 for M².

DISCUSSION. Specimens of *Pareumys* sp., aff. *P. milleri*, are very rare in the Sespe Formation; only two upper molars [LACM(CIT) 2214, 2215] have previously been referred to this species (Wilson, 1940c). Fusion of the metalophs with the posterior cingulae of the upper molars in LACM 128892 is not as complete as in LACM(CIT) 2214 and 2215; however, this may be due to differences in stage of wear. S.L. Walsh (personal communication) considers the fusion of the metaloph with posterior cingulum in the larger samples of *Pareumys* from the Friars and Mission Valley Formations in the San Diego area to be variable and not a reliable diagnostic character.

According to Wilson (1940c) the sample of *Pareumys* from the Pearson Ranch Local Fauna differs from *P. milleri* in having the following characters: P₄ slightly more reduced; metalophid apparently incomplete and not uniting with the posterior cingulum; M₁₋₂ narrower transversely; crown of cheek

teeth apparently slightly flatter topped; masseter muscle scar perhaps less anterior in position. Wilson (1940c) noted that all of these characters are subject to individual variation but considered the flattened occlusal surfaces of the teeth to be the most important difference and to represent a more derived evolutionary stage. The upper molars described herein are less worn than the previously described upper molars but also exhibit the flatter occlusal surfaces. Black and Sutton (1984) referred all the material from the Pearson Ranch Fauna and the "Ventura County, Sespe Formation" (= Brea Canyon Local Fauna) to *P. milleri*, presumably because the differences between the specimens from the Sespe Formation and type and topotypic material from the Myton Member of the Uinta Formation in Utah are minor. Until much larger samples are available and intraspecific variation in the Sespe Formation samples can be thoroughly analyzed, the specimens from the Pearson Ranch Local Fauna are referred to *P. sp.*, aff. *P. milleri*.

Wilson (1940c) identified an upper molar [LACM(CIT) 2224] from LACM(CIT) loc. 207 as *Pareumys* sp. and stated that it differs from the Pearson Ranch specimens in having a more distinct groove between the protocone and hypocone, less fusion of the metaloph and the posterior cingulum, and more discrete cusps. The M¹ described herein closely matches this tooth in size, metaloph morphology, and the presence of a distinct groove between the protocone and hypocone. The characters that Wilson (1940c) used to differentiate the upper molar from LACM(CIT) loc. 207 and those from the Pearson Ranch Local Fauna are probably not reliable because they appear to be the result of different stages of wear. Therefore, LACM(CIT) 2224 from LACM(CIT) loc. 207 is herein tentatively referred to *P. sp.*, aff. *P. milleri*.

Wilson (1940c) also identified fragmentary material, including several lower molars from LACM(CIT) loc. 202 as *Pareumys* sp. These specimens, though similar in size, exhibit minor morphological differences relative to comparable material of *P. sp.*, aff. *P. milleri*, from the Pearson Ranch Local Fauna. It is also possible that these specimens and the Pearson Ranch specimens are conspecific; however, confirmation must await better material.

Lillegraven (1977) identified specimens from the Camp San Onofre Local Fauna at Camp Pendleton as *Pareumys* sp. and noted that they differed from *P. sp.*, aff. *P. milleri*, of the Pearson Ranch Local Fauna in having slightly less fusion of the metaloph and the posterior cingulum. At that time, only two well worn molars of *P. sp.*, aff. *P. milleri*, had been described (Wilson, 1940c). The molars of *P. sp.*, aff. *P. milleri*, described herein are less worn and the metaloph and the protoloph show less fusion, indicating this character may vary with wear. The Pearson Ranch specimens are slightly larger than those from Camp Pendleton.

The sample of *Pareumys* sp., aff. *P. milleri*, from

the Pearson Ranch and Brea Canyon Local Faunas, *Pareumys* sp. from the Brea Canyon Local Fauna at LACM(CIT) loc. 202, and *Pareumys* sp. from the Camp San Onofre Local Fauna appear to represent allied populations that may be conspecific or represent a group of closely related species. These taxa differ from the more primitive *Pareumys* sp., near *P. grangeri* Burke (Wilson, 1940c) from the Friars and Mission Valley Formations in the San Diego area, in having the following characters: larger teeth; metaloph bends toward the posterior cingulum with a greater tendency to fuse with the cingulum; cheek teeth exhibit greater hypsodonty and more completely developed lophs.

LOCAL FAUNAS

Stock (1932, 1933a,b,c,d, 1934a,b,c,d, 1935a,b,c,d, 1936a,b,c, 1939, 1948) was the first to define the fossil land mammal assemblages from the Sespe Formation in Simi Valley, where he recognized two faunas—the Tapo Ranch and Pearson Ranch Faunas. The Tapo Ranch Fauna included the assemblages from LACM(CIT) locs. 127, 151, 202, and 207, which are present low in the Brea Canyon section, and from LACM(CIT) locs. 180 and 217 in Dry Canyon. The Pearson Ranch Fauna included the assemblages from LACM(CIT) locs. 128, 145, 146, 147, 148, 149, and 150. Stock (1948) placed the Pearson Ranch localities approximately 183 to 214 m (600 to 700 ft) stratigraphically above the Tapo Ranch localities; however, the complexity of the stratigraphic section resulting from faulting was not recognized at the time.

Golz (1976) and Golz and Lillegraven (1977), realizing the stratigraphic relations of the localities in Dry and Brea Canyons were uncertain and that each area produced faunas with differing taxa, divided the Tapo Ranch Fauna into two local faunas—the Brea Canyon Local Fauna, which includes the assemblages from LACM(CIT) locs. 127, 151, 152, 154, 202, and 207, and the Tapo Canyon Local Fauna, which includes the assemblages from LACM(CIT) locs. 180 and 217. Unfortunately, LACM(CIT) locs. 180 and 217, which produced the majority of specimens comprising the Tapo Canyon Local Fauna, are not in Tapo Canyon, but in Dry Canyon, the first large canyon west of Tapo Canyon. However, to maintain nomenclatural stability, the name Tapo Canyon Local Fauna is retained.

Extensive fieldwork conducted for the present study reveals that LACM(CIT) locs. 180 and 217 are located very low in the lower part of the middle member and are from a stratigraphic level within 20 m of bed CS1 in Brea Canyon. The Tapo Canyon Local Fauna is redefined to include not only the assemblages from LACM(CIT) locs. 180 and 217, but also those from bed CS1 in Brea Canyon. The Tapo Canyon Local Fauna is stratigraphically the lowest and, therefore, the oldest local fauna from Simi Valley (Fig. 4).

Golz (1976) considered the Pearson Ranch Fauna

a local fauna because it is more restricted geographically and stratigraphically than a fauna. The Pearson Ranch Local Fauna is divided here into two local faunas that are stratigraphically and taxonomically distinct. The name Pearson Ranch Local Fauna is retained for nomenclatural stability but is redefined to include only the assemblages from the localities that are present in bed SS15 and above. The redefined Pearson Ranch Local Fauna still includes the assemblage from LACM(CIT) loc. 150, the “type assemblage” of the Pearson Ranch Fauna of Stock (1932). The assemblages from beds CS8 through CS14, which lie below the Pearson Ranch Local Fauna, are reassigned to the Strathern Local Fauna (new). The stratigraphic relations of the local faunas discussed above are shown in Figure 4, and the stratigraphic ranges of the taxa comprising these local faunas are presented in Table 1.

TAPO CANYON LOCAL FAUNA

The Tapo Canyon Local Fauna includes the assemblages from LACM(CIT) locs. 180 and 217 in Dry Canyon, along with those from the lowermost Brea Canyon localities—LACM(CIT) loc. 154 and LACM locs. 5621 through 5623 (Fig. 4). The Tapo Canyon Local Fauna is characterized by the restricted stratigraphic ranges of the following species: *Apatemys downsi* Gazin, 1958; *Miacis? hookwayi* Stock, 1934c; *Craseops sylvestris* Stock, 1934b; *Phenacolemur* sp., cf. *P. shifrae* Robinson, 1968; *Dilophodon* sp.; *Leptoreodon edwardsi*; *Tapomys tapensis* (Wilson, 1940a); *Leptotomus* sp., cf. *L. caryophilus* Wilson, 1940a; *Leptotomus* sp., cf. *L. leptodus* (Cope, 1873); *Ischyrotomus* sp., cf. *I. compressidens* (Peterson, 1919); *Microparamys* sp. D; *Eohaplomys tradux* Stock, 1935a. Mason (1988, unpublished) has also reported a new species of *Simimeryx* from the Tapo Canyon Local Fauna, which is the first Uintan record of the genus.

BREA CANYON LOCAL FAUNA

The Brea Canyon Local Fauna is comprised of the assemblages from beds CS2 through CS6, which lie from about 50 to 100 m above the highest strata containing the Tapo Canyon Local Fauna, and includes the assemblages from LACM(CIT) locs. 127, 151, 152, 202, and 207, and other LACM and UCMP localities (see Fig. 4). The Brea Canyon Local Fauna is characterized by the restricted stratigraphic ranges of the following species: *Macrotarsius roederi* n. sp.; *Protylopus* sp., cf. *P. petersoni* Wortman, 1898; *Protylopus stocki* Golz, 1976; *Protylopus? robustus* Golz, 1976; *Protylopus? sp.*, cf. *P.? robustus*; *Protylopus? sp.*, aff. *P.? robustus*; *Leptoreodon pusillus*; *Mytonomys burkei*; *Rapamys fricki*; *Tapomys* sp.; *Eohaplomys matutinus* Stock, 1935a; *Eohaplomys serus* Stock, 1935a.

STRATHERN LOCAL FAUNA

The Strathern Local Fauna (new) is comprised of the assemblages from beds CS8 through CS14, which

lie from about 200 to 300 m above the highest strata containing the Tapo Canyon Local Fauna, and includes the assemblages from LACM(CIT) loc. 128; LACM locs. 5633, 5634, and 5636; and probably LACM(CIT) loc. 149 and UCMP loc. V-87156 (Fig. 4). The Strathern Local Fauna is a transitional fauna that contains taxa typical of both the late Uintan Brea Canyon Local Fauna and the early Duchesnean Pearson Ranch Local Fauna. Only two species are restricted to the local fauna, *Leptoreodon* sp., cf. *L. pusillus*, and *Mytonomys* sp., cf. *M. mytonensis*. However, the Strathern Local Fauna is also characterized by the first appearances of *Simimeryx hudsoni* Stock, 1934d, in bed CS8 and *Protoreodon pacificus* Golz, 1976, in bed CS13, and the last occurrences of *Protoreodon* "*pumilus*" in bed CS13 and *Dyseolemur pacificus* in bed CS14. The presence of a primitive new species of *Simimeryx* in the underlying Tapo Canyon Local Fauna (Mason, 1988) indicates the earliest appearance of *Simimeryx hudsoni* in bed CS8 represents an autochthonous speciation event.

The Strathern Local Fauna differs from the Pearson Ranch Local Fauna by the apparent lack of the following genera: *Hyaenodon*, *Amynodontopsis*, *Duchesneodus*, *Eotylopus*, *Presbymys*.

PEARSON RANCH LOCAL FAUNA

The Pearson Ranch Local Fauna (restricted) is comprised of the assemblages from the upper half of bed SS15 through bed SS22, which lie from about 315 to 475 m above the highest strata containing the Tapo Canyon Local Fauna, and includes the assemblages from LACM(CIT) locs. 145, 146, 147, 148, and 150 and other LACM and UCMP localities (see Fig. 4).

During field investigations conducted for this study, four new localities (LACM 5611 through 5614) were found at the head of the southeastern fork of the small canyon near the lower east side of Alamos Canyon. The most productive site (LACM loc. 5611) is in the lowest mottled red-gray claystone bed of the southeast-facing exposure. Locality LACM(CIT) 179 is in the northwest-facing exposure of this small canyon (Fig. 1). The original sample of fossils from LACM(CIT) loc. 179 was either lost or misplaced when transferred from CIT to LACM. The assemblages from LACM(CIT) loc. 179 and LACM locs. 5611 through 5614 are included in the Pearson Ranch Local Fauna because the strata that yielded these assemblages lie above the western extension of the Strathern fault and can be traced to a stratigraphic interval in west Brea Canyon containing beds CS15 through CS18.

The Pearson Ranch Local Fauna is characterized by the restricted stratigraphic ranges of *Chumashius balchi* Stock, 1933d; *Hyaenodon vetus* Stock, 1933a; *Hyaenodon venturae* Melleit, 1977; *Amynodontopsis bodei* Stock, 1933c; *Duchesneodus californicus* (Stock, 1935d); *Protylopus pearsonensis* Golz, 1976; *Eotylopus* sp.; and *Presbymys lophatus*

Wilson, 1949. The earliest appearance of *Hyaenodon*, *Amynodontopsis*, and *Duchesneodus*, taxa that were widespread during the Duchesnean in western North America, may represent an immigration event arising from Asia (Krishtalka *et al.*, 1987).

BIOSTRATIGRAPHY

A detailed biostratigraphic summary of the Eocene fossil mammal taxa from Simi Valley is presented in Table 1. Certain taxa that are common throughout the section, or are biostratigraphically significant, are discussed below.

The insectivores *Sespedectes singularis* Stock, 1935c, and *Proterixoides davisii* Stock, 1935c, are present throughout the Brea Canyon section. Novacek (1985) reported that combined samples of these species lumped from the Pearson Ranch and the Brea Canyon Local Faunas exhibit rather high coefficients of variation, but it is not possible to recognize any consistent morphologic differences that could be used to separate distinct species within these samples. The pantolestid *Simidectes merriami* Stock, 1933b, is recorded only from the Pearson Ranch Local Fauna at LACM(CIT) loc. 150 (bed CS20).

Primates are relatively rare in the Sespe Formation. *Chumashius balchi* is present only in the Duchesnean Pearson Ranch Local Fauna at LACM(CIT) locs. 146 (bed SS15) and 150 (bed CS20). *Dyseolemur pacificus*, previously recorded from the late Uintan Brea Canyon and Tapo Ranch Local Faunas, is now also recorded from the latest Uintan or earliest Duchesnean Strathern Local Fauna. *Macrotarus roederi* n. sp. is known only from the holotype, which was found in bed CS3 (Brea Canyon Local Fauna).

Creodonts and carnivores are relatively rare in the Sespe Formation. *Hyaenodon* first appears in bed CS20 at LACM(CIT) loc. 150. *Hyaenodon* has been recorded from Duchesnean to Arikarean faunas in the mid-continental United States (Savage and Russell, 1983), and its earliest appearance is considered diagnostic of the early Duchesnean (Wilson, 1986; Krishtalka *et al.*, 1987). *Miacis? hookwayi* Stock, 1934c, is restricted to the Tapo Canyon Local Fauna. *Tapocyon occidentalis* Stock, 1934c, previously thought to be restricted to the Tapo Canyon Local Fauna (Mason, 1988), was discovered in bed CS3 during the present study, extending its range upward into the Brea Canyon Local Fauna. *Procyonodictis progressus* (Stock, 1935b) is recorded from the Tapo Canyon and Brea Canyon Local Faunas.

Amynodonts and brontotheres appear to be more abundant in the Duchesnean strata of Simi Valley than in the Uintan. *Amynodontopsis* first appears in bed SS16 and is also present in beds SS18 through CS20. *Amynodontopsis* is also recorded from Duchesnean faunas in South Dakota, Texas, and Utah. *Duchesneodus* first appears in the upper half of bed

SS15 and continues upward into bed SS22. *Duchesneodus* was widely distributed in western North America (California, New Mexico, South Dakota, Texas, Utah) during the middle and late Eocene and, like *Amynodontopsis*, is restricted to the Duchesnean (Lucas *et al.*, 1981; Wilson and Schiebout, 1981; Wilson, 1986; Krishtalka *et al.*, 1987). For these reasons, the first local appearances of *Duchesneodus* and *Amynodontopsis* can be used for correlating Duchesnean land mammal assemblages.

Artiodactyls are one of the most common groups from the Sespe Formation in Simi Valley. *Simimeryx hudsoni* first appears in bed CS8 and its abundance increases up section, becoming the predominant artiodactyl in beds CS13 through CS20. *Eotylopus* first appears in bed CS20 at LACM(CIT) loc. 150.

Golz (1976) referred the agriochoerid specimens from the Uintan of Simi Valley to *Protoreodon pumilus* (Marsh, 1875), whereas he referred the smaller, more derived specimens from the Duchesnean to *Protoreodon pacificus*. It must be noted that the taxonomic status of *P. pumilus* is a matter of controversy. Wilson (1971) considered the taxon a species group; however, Lander (in lit.) does not consider the specimens referred to *P. pumilus* by Wilson (1971) to be the same species as the holotype for *P. pumilus*, instead assigning them to *Protoreodon annectens* (Scott, 1899). Lander (in lit.) refers specimens from the Brea Canyon Local Fauna to *P. annectens tardus* Scott, 1945, and those from the Strathern and Pearson Ranch Local Faunas to *P. annectens pacificus*. *Protoreodon pacificus* can be easily distinguished from *P. pumilus* by its smaller size, narrower premolars, and more progressive premolar-molar series (Golz, 1976). Moreover, specimens of *P. pumilus*, identified herein as *P. "pumilus"*, and *P. pacificus* occur together at LACM(CIT) loc. 128, which further affects the issue of their specific or subspecific status. *Protoreodon "pumilus"* is recorded from bed CS13 (Strathern Local Fauna) and from stratigraphically lower in the section at LACM(CIT) locs. 127, 202, and 207 (Brea Canyon Local Fauna). *Protoreodon pacificus* is the characteristic agriochoerid from the Duchesnean of Simi Valley and first appears in bed CS13.

Leptoreodon sp., cf. *L. pusillus*, is present in bed CS13 at LACM(CIT) loc. 128 (Strathern Local Fauna) and is closely related to *P. pusillus*, which is present in bed CS6 at LACM(CIT) loc. 5620 (Brea Canyon Local Fauna). *Leptoreodon stocki* n. sp. is present in the Tapo Canyon, Brea Canyon, Strathern, and Pearson Ranch Local Faunas.

Rodents from the Pearson Ranch Local Fauna are represented by relatively small samples compared to those from other Duchesnean and Uintan assemblages in southern California. *Presbymys lo-phatus* has only been recovered from CS20 at LACM(CIT) loc. 150. *Pareumys* sp., aff. *P. milleri*, is recorded from the Brea Canyon and Pearson Ranch Local Faunas. *Rapamys* is now recorded from the Pearson Ranch Local Fauna, and this rec-

ord extends the range of the genus into the Duchesnean. *Microparamys tricus* (Wilson, 1940a) first appears in bed CS15 and is restricted to the Duchesnean Pearson Ranch Local Fauna. Mason (1988) referred a specimen (UCMP 132048) from LACM(CIT) loc. 149 to *Leptotomus* sp., cf. *L. mytonensis* (Cope, 1873), and this specimen is herein referred to *Mytonomys* sp., cf. *M. mytonensis*, as recognized by Korth (1988).

DUCHESNEAN LAND MAMMAL AGE

CHARACTERIZATION

Wood *et al.* (1941) based the Duchesnean "North American Provincial Age", now regarded as a land mammal age, on assemblages from the Duchesne River Formation of Utah and included the Pearson Ranch Fauna of Simi Valley as a correlative fauna. Kay (1934) originally recognized three fossiliferous horizons within the Duchesne River Formation. In ascending order, these horizons and their respective faunas were referred to as the Randlett, Halfway, and Lapoint. Andersen and Picard (1972) defined three members within the Duchesne River Formation, including the Brennan Basin (= Randlett and lower Halfway Horizons), Dry Gulch Creek (= upper two-thirds of Halfway Horizon), and the Lapoint Members (= Lapoint Horizon). The Lapoint Member and the upper portion of the Dry Gulch Creek Member are not highly fossiliferous, and unfortunately, detailed biostratigraphic information is lacking (Black and Dawson, 1966a; Emry, 1981).

The Duchesnean is not well defined, and its validity as a land mammal age is the subject of controversy. Scott (1945) regarded the Randlett, Halfway, and Lapoint Faunas as younger than the faunas of the Uinta Formation and referred these faunas to the Oligocene without reference to land mammal ages. Gazin (1955) considered the Randlett Fauna to be Uintan and the Halfway and Lapoint Faunas to be Duchesnean in age. Clark *et al.* (1967) and Tedford (1970) restricted the Duchesnean to the assemblages from the Lapoint Member and its correlatives, whereas Emry (1981) suggested that the Duchesnean be regarded as a subage of the Chadronian and referred the Lapoint and Halfway Faunas to the earliest Chadronian. Wilson (1977) did not recognize the Duchesnean in an early study of the faunas from Trans-Pecos, Texas, but in a later study, Wilson (1986) recognized the Duchesnean as late and early subages of the Uintan and Chadronian, respectively. Storer (1987, 1988), based on a study of small mammals from the La Pelletier Lower Fauna in Saskatchewan, concluded the Duchesnean Land Mammal Age is marked by an O-type episode of rapid faunal turnover caused by a wave of originations.

Whether the Lapoint Fauna should be considered representative of the late Duchesnean subage of the Chadronian or be regarded as belonging to the Duchesnean Land Mammal Age is a matter of

interpretation of these ages as originally defined by Wood *et al.* (1941). Although it is beyond the scope of this paper to resolve the Duchesnean-Chadronian controversy, following Wood *et al.* (1941) the Lapoint Fauna is herein referred to the Duchesnean Land Mammal Age as originally defined, not to a late Duchesnean subage of the Chadronian.

Presently, most authors regard the assemblages from the upper Dry Gulch Creek and Lapoint Members as representing the Duchesnean, and, based on similarities to Uintan faunas, refer the Randlett Fauna of the Brennan Basin Member and Halfway Fauna of the upper Brennan Basin and lower Dry Gulch Creek Members to the Uintan (Gazin, 1955; Black and Dawson, 1966a; Clark *et al.*, 1967; Tedford, 1970; Golz, 1976; Savage and Russell, 1983; Krishtalka *et al.*, 1987). However, Mason (1988) provided the most recent faunal list of the assemblage from the Dry Gulch Creek Member, reviewed the stratigraphic provenance of each taxon within this member, and concluded that it is premature to exclude this assemblage from the Duchesnean. This would suggest that the Halfway Fauna, in part, could be Duchesnean; however, only precise stratigraphic collecting from the Dry Gulch Creek Member will determine its age.

Radiometric dates associated with Duchesnean faunas are meager. The Lapoint Fauna lies above an ash siltstone that occurs at the contact of the Lapoint and Dry Gulch Creek Members and is dated at 40.4 Ma (McDowell *et al.*, 1973). Krishtalka *et al.* (1987) reported that J.A. Wilson redated this ash, resulting in a date of 40.6 Ma. A Duchesnean assemblage from Badwater locality 20 in the Badwater Creek area of Wyoming is associated with a tuff dated at 42.3 ± 1.4 Ma (Black, 1969). Berggren *et al.* (1985) correlate the Duchesnean with the late middle to late Eocene and consider it to be 42 to 37–38 Ma in age.

Krishtalka *et al.* (1987) defined the lower boundary of the Duchesnean by the first appearances of *Hyaenodon*, *Duchesneodus*, *Hyracodon*, *Agriochoerus*, *Brachyhyops*, *Simimeryx*, and *Poabromylus* and suggested that some of these taxa may represent an immigration event from Asia similar in magnitude to faunal events that have been used to define other Eocene land mammal age boundaries. However, the presence of *Simimeryx* in the late Uintan Tapo Canyon Local Fauna (Mason, 1988) eliminates the first appearance of this genus as diagnostic of the Duchesnean. Wilson (1986) characterized the Duchesnean by the first appearances of *Hyaenodon*, *Daphoenus*, *Duchesneodus*, *Hyracodon*, *Amynodontopsis*, *Brachyhyops*, *Agriochoerus*, *Poabromylus*, and *Eotylopus* and the last occurrences of *Hessolestes*, *Simidectes*, *Harpagolestes*, *Duchesneodus*, *Amynodontopsis*, *Hyopsodus*, *Diplobunops*, and *Simimeryx*.

DUCHESNEAN OF SIMI VALLEY

A comprehensive biostratigraphic record of superposed, fossil-bearing strata that cross the Uintan–

Duchesnean boundary in Simi Valley is presented in Table 1. The Duchesnean of Simi Valley is characterized by the first appearances of *Chumashius balchi*, *Hyaenodon vetus*, *H. venturae*, *Duchesneodus californicus*, *Amynodontopsis bodei*, *Protylopus pearsonensis*, *Eotylopus* sp., and *Presbymys lophatus*.

Table 16 lists the mammalian genera found in the late Uintan and Duchesnean assemblages of southern California and their combined Pacific Coast and mid-continental temporal distributions. Of 38 genera represented in southern California, two are restricted to (*Duchesneodus*, *Amynodontopsis*), four first appear in (*Hyaenodon*, *Duchesneodus*, *Amynodontopsis*, *Eotylopus*), and 11 last occur in the Duchesnean (*Simidectes*, *Sespedectes*, *Proterixoides*, *Leptoreodon*, *Protylopus*, *Simimeryx*, *Rapamys*, *Pareumys*, *Presbymys*, “*Namatomys*”, *Simimys*).

SUBDIVISIONS OF THE DUCHESNEAN

Many authors have correlated the Pearson Ranch Local Fauna with the Lapoint Fauna (for example, Wood *et al.*, 1941; Black and Dawson, 1966a; Tedford, 1970; Golz, 1976; Emry, 1981; Savage and Russell, 1983); however, Wilson (1986) presented evidence for assigning the Lapoint Fauna to a younger age than the Pearson Ranch Local Fauna.

Wilson (1986) characterized the early Duchesnean by the common occurrences of *Simidectes*, *Hyaenodon*, *Duchesneodus*, and *Amynodontopsis*, and the late Duchesnean by the common occurrences of *Hyaenodon*, *Duchesneodus*, *Hyracodon*, *Brachyhyops*, and *Poabromylus*. Wilson (1986) assigned the Skyline Local Fauna (Agua Fria-Green Valley area, Trans-Pecos, Texas), Pearson Ranch Local Fauna [LACM(CIT) loc. 150], and the assemblages from Badwater locality 20 and the Wood locality (Badwater area, Wyoming) to the early Duchesnean, and the Lapoint Fauna and the Porvenir Local Fauna (Vieja-Ojinaga area, Trans-Pecos, Texas) to the late Duchesnean. The Porvenir Local Fauna contains many taxa not recorded from the Lapoint Member but, like the Lapoint Fauna, shows a greater similarity to faunas of Chadronian than to those of Uintan age (Wilson, 1986, fig. 5).

The Lapoint Fauna contains *Hyaenodon*, *Duchesneodus*, *Hyracodon*, *Brachyhyops*, *Simimeryx*, and *Poabromylus*. Of these taxa, only *Hyaenodon*, *Duchesneodus*, and *Simimeryx* are present in the Pearson Ranch Local Fauna. Wilson’s (1986) conclusion that the Pearson Ranch Local Fauna is older than the Lapoint Fauna or the Porvenir Local Fauna is further supported herein by the identification of *Leptoreodon* from the Pearson Ranch Local Fauna. *Leptoreodon* is common in Uintan assemblages but is not present in the Lapoint Fauna or Porvenir Local Fauna. Furthermore, *Hydracodon* and *Brachyhyops*, which are also found in Chadronian assemblages, are not recorded from

the Pearson Ranch Local Fauna. These data strongly suggest a younger age for the Lapoint Fauna. For this reason, the Lapoint Fauna is herein considered late Duchesnean in age.

The Pearson Ranch Local Fauna is present in the upper half of bed SS15 through bed SS22 and is characterized by the first appearances of *Duchesneodus californicus*, *Amyndontopsis bodei*, *Hyaenodon venturae*, *Hyaenodon vetus*, *Protylopus pearsonensis*, *Eotylopus* sp., and *Presbymys lophatus* and the occurrences of *Sespedectes singularis*, *Proterixoides davis*i, *Simidectes merriami*, *Chumashius balchi*, *Triplopus?* *woodi* Stock, 1936c, *Protoreodon pacificus*, *Leptoreodon stocki* n. sp., *Simimeryx hudsoni*, *Microparamys tricus*, *Pareumys* sp., aff. *P. milleri*, *Griphomys alecer* Wilson, 1940b, and *Simimys simplex* (Wilson, 1935a). The Pearson Ranch Local Fauna is older than the Lapoint Fauna and Porvenir Local Fauna, as indicated by its containing a greater number of taxa having affinities with those of the Uintan than the Chadronian. The Pearson Ranch Local Fauna is herein regarded as early Duchesnean in age.

The Strathern Local Fauna is present in beds CS8 through CS14 and is characterized by the first appearances of *Simimeryx hudsoni* and *Protoreodon pacificus*, the last occurrences of *Dyseolemur pacificus*, *Protoreodon* “*pumilus*”, and *Leptoreodon* sp., cf. *L. pusillus*, and by the occurrences of *Sespedectes singularis*, *Proterixoides davis*i, *Triplopus?* *woodi*, *Leptoreodon stocki* n. sp., and *Mytonomys* sp., cf. *M. mytonensis*. The fauna is of transitional Uintan–Duchesnean age, with a combination of species typical of the late Uintan (*D. pacificus*, *P. “pumilus”*) and the Duchesnean (*P. pacificus*, *S. hudsoni*). The fauna lacks taxa (*Hyaenodon*, *Duchesneodus*, *Amyndontopsis*, *Eotylopus*, *Presbymys*) diagnostic of the overlying early Duchesnean Pearson Ranch Local Fauna. The Strathern Local Fauna lies immediately below the Pearson Ranch Local Fauna and about 100 m above the late Uintan Brea Canyon Local Fauna. The Strathern Local Fauna does not contain the first appearance of any diagnostic Duchesnean genus and should be regarded as latest Uintan. The Uintan–Duchesnean boundary can be considered to be at the first appearance of the diagnostic Duchesnean taxon *Duchesneodus* in bed SS15; however, the sample size of *Duchesneodus* from Simi Valley is small, and the apparent absence of this genus in the Strathern Local Fauna is not unequivocal. Furthermore, *Triplopus?* *woodi* is present in the Pearson Ranch and Strathern Local Faunas but not in the late Uintan Brea Canyon Local Fauna. It is premature to restrict the Strathern Local Fauna to the Uintan, and this fauna could be latest Uintan or earliest Duchesnean.

UINTAN LAND MAMMAL AGE

The Uinta Formation of the Uinta Basin in Utah is the stratotype of the Uintan age (Wood *et al.*, 1941).

Table 16. Mammalian genera found in late Uintan and Duchesnean assemblages in southern California, with combined geochronologic ranges along the Pacific Coast and in the mid-continental United States (Duch. = Duchesnean; Chad. = Chadronian).

Genera	Uintan	Duch.	Chad.
<i>Peratherium</i>			
<i>Peradectes</i>			
<i>Mytonolagus</i>			
<i>Simidectes</i>			
<i>Apatemys</i>			
<i>Hyaenodon</i>			
<i>Procyonodictis</i>			
<i>Miacis</i>			
<i>Tapocyon</i>			
<i>Sespedectes</i>			
<i>Proterixoides</i>			
<i>Craseops</i>			
<i>Dyseolemur</i>		_____?	
<i>Chumashius</i>			
<i>Macrotarsius</i>			
<i>Duchesneodus</i>		_____	
<i>Dilophodon</i>	_____		
<i>Amyndodon</i>	_____		
<i>Amyndontopsis</i>		_____	
<i>Tapochoerus</i>	_____		
<i>Protoreodon</i>	_____		
<i>Leptoreodon</i>	_____		
<i>Poebrodon</i>	_____		
<i>Protylopus</i>	_____		
<i>Eotylopus</i>		_____	
<i>Simimeryx</i>	_____		
<i>Leptotomus</i>	_____		
<i>Mytonomys</i>	_____		
<i>Tapomys</i>	_____		
<i>Microparamys</i>	_____		
<i>Rapamys</i>	_____		
<i>Ischyrotomus</i>	_____		
<i>Pareumys</i>	_____		
<i>Presbymys</i>	_____		
“ <i>Namatomys</i> ”	_____		
<i>Griphomys</i>	_____		
<i>Eohaplomys</i>	_____		
<i>Simimys</i>	_____		

Wood (1934) divided the Uinta Formation into the Wagonhound and the overlying Myton Members. The Duchesne River Formation overlies and, in its lower 325 m (1064 ft), interfingers with the Myton Member of the Uinta Formation (Andersen and Picard, 1972).

The characteristic Uintan taxa from southern California are *Procyonodictis*, *Tapocyon*, *Craseops*, *Stockia*, *Dilophodon*, *Amyndodon*, *Tapochoerus*, *Merycobunodon*, *Pöebrodon*, *Tapomys*, and *Eohaplomys*.

Krishtalka *et al.* (1987) discussed the history of the faunal divisions of the Uinta Formation. The Uintan is currently subdivided into early and late segments. The early Uintan is typified by the assem-

blages from the Wagonhound Member, and the late Uintan by the assemblages from the Myton Member and the Brennan Basin and lower Dry Gulch Creek Members of the Duchesne River Formation (Krishtalka *et al.*, 1987). However, as noted above, the fossil record from the Dry Gulch Creek Member is poor, and Mason (1988) considers its age uncertain. In ascending stratigraphic order, the localities that produced most of the taxa from the Myton Member are Leland Bench Draw, Myton Pocket, and Leota Ranch.

Krishtalka *et al.* (1987) characterize the early Uintan by the first appearances of *Epihippus*, *Metarhinus*, *Dolichorhinus*, hyracodonts, amynodonts, *Mytonomeryx*, *Bunomeryx*, *Hylomeryx*, *Mesomeryx*, *Achaenodon*, agriocherids, oromerycids, and protoptychids and the last occurrences of *Metarhinus*, *Telmatherium*, taeniodonts, uintatheres, and *Protoptychus*. Krishtalka *et al.* (1987) characterize the late Uintan by the first appearances of *Domnina*, *Simidectes*, *Thylacaelurus*, *Procyonodictis*, *Prodaphoenus*, *Colodon*, *Pöebrodon*, and *Epitriplopus*. *Tapocyon* (Stock, 1934c; Dawson, 1980), *Chumashius* (Robinson, 1968; Krishtalka, 1978; Lillegraven, 1980), and *Simimeryx* (Mason, 1988) also have first appearances in the late Uintan.

AGE AND CORRELATION OF MIDDLE AND LATE EOCENE LAND MAMMAL ASSEMBLAGES

The Eocene fossil mammal assemblages from the lower part of the middle member of the Sespe Formation in Simi Valley can be correlated with other middle and late Eocene assemblages from California, Texas, Wyoming, and Utah.

CALIFORNIA

Golz (1976), Golz and Lillegraven (1977), and Lillegraven (1980) characterized the Eocene land mammal assemblages from the San Diego area in southern California. These faunal assemblages include the late Bridgerian or early Uintan assemblage from the Ardath Shale, and the early Uintan assemblages from the Friars Formation, Stadium Conglomerate, and the Mission Valley Formation. However, Walsh (1987), in a study of the southern outcrops of the Mission Valley Formation in the San Diego area, has suggested these assemblages be divided into two faunas as follows: the early Uintan Poway Fauna from the Friars Formation in the greater San Diego area and from the outcrops of the Mission Valley Formation at Rancho Peñasquitos and Rancho Bernardo in the Poway area, and the late Uintan Cloud 9 Fauna from the southern outcrops of the Mission Valley Formation in the eastern part of the greater San Diego area.

Three local faunas, which range in age from late Uintan to Duchesnean, were reported from the Santiago Formation in the Carlsbad area by Golz (1976), Golz and Lillegraven (1977), and Lillegraven (1977, 1980). These faunas include the Laguna Riviera,

Camp San Onofre, and the Chestnut Avenue Local Faunas. The ages of the assemblages from the Carlsbad area and the Cloud 9 Fauna are reassessed below in light of the results of the present study.

During the present study, *Dyseolemur pacificus*, *Protoreodon* "*pumilus*", and *Leptoreodon*, taxa previously recorded only from late Uintan assemblages in the Carlsbad area and Simi Valley, were also found in the latest Uintan or earliest Duchesnean Strathern Local Fauna. Moreover, Golz and Lillegraven (1977) and Lillegraven (1977, 1980) have identified *Chumashius balchi*, *Simimeryx* sp., cf. *S. hudsoni*, and *Microparamys tricus* in the Camp San Onofre Local Fauna, which they considered late Uintan in age.

In Simi Valley, *S. hudsoni* is recorded only from the Strathern and Pearson Ranch Local Faunas, and *C. balchi* and *M. tricus* only from the Pearson Ranch Local Fauna. In the Carlsbad area, *C. balchi* and *M. tricus* are only present at UCMP loc. V-72088 (Camp San Onofre Local Fauna), and *Simimeryx* only at UCMP locs. V-72088 and V-71053 (Chestnut Avenue Local Fauna). The Camp San Onofre Local Fauna is from an isolated exposure of the Santiago Formation on the Camp Pendleton Marine Corps Base, and its stratigraphic position relative to the other assemblages in the Santiago Formation is uncertain. Field studies, which were conducted by the author for this study, indicate the Chestnut Avenue Local Fauna is stratigraphically higher in the Santiago Formation than the Laguna Riviera Local Fauna. The assignment of the Camp San Onofre Local Fauna to the late Uintan by Lillegraven (1977, 1980) extended the geologic ranges of *C. balchi* and *M. tricus* downward. Golz (1976) considered the Chestnut Avenue Local Fauna to be late Uintan or Duchesnean.

Lillegraven (1977) regarded the Camp San Onofre Local Fauna as a correlative of the Uintan assemblages from Simi Valley because of the joint occurrences of the rodent genera *Microparamys*, *Griphomys*, and *Pareumys*, and possibly the joint occurrences of three species of these genera (*M. tricus*, *G. alecer*, *Pareumys* sp.). However, these genera are also present in the early Duchesnean Pearson Ranch Local Fauna. Furthermore, *M. tricus* is actually restricted to the Pearson Ranch Local Fauna, and *G. alecer* is also recorded in the Pearson Ranch Local Fauna (Black and Sutton, 1984). The diagnostic dental character (fusion of lingual end of metaloph to posterior cingulum), which Lillegraven (1977) used to demonstrate the sample of *Pareumys* sp. from the Camp San Onofre Local Fauna as being distinct from and less derived than the sample of *P. sp.*, aff. *P. milleri*, of the Pearson Ranch Local Fauna, is now known to be unreliable because it varies intraspecifically. Moreover, the upper molars from the Pearson Ranch Local Fauna herein assigned to *P. sp.*, aff. *P. milleri*, cannot be distinguished from *Pareumys* sp. from the Camp San Onofre Local Fauna on the basis of this character. Lillegraven (1980) later reported *Chumashius*

balchi and *Dyseolemur pacificus* from the Camp San Onofre Local Fauna. The presence of *D. pacificus* in the Camp San Onofre Local Fauna, a taxon previously reported only from late Uintan assemblages in Simi Valley, appeared to support a late Uintan age assignment. However, *D. pacificus* is now known from the latest Uintan or earliest Duchesnean Strathern Local Fauna, and *C. balchi* is restricted to the early Duchesnean Pearson Ranch Local Fauna.

The Camp San Onofre Local Fauna and the Pearson Ranch Local Fauna share five species (*Proterixoides davisii*, *Chumashius balchi*, *Microparamys tricus*, *Simimys simplex*, *Griphomys alecer*). The Camp San Onofre Local Fauna has slightly greater affinities with the Pearson Ranch Local Fauna than with the Brea Canyon Local Fauna, which lacks *C. balchi* and *M. tricus*. The Camp San Onofre Local Fauna and the latest Uintan or earliest Duchesnean Strathern Local Fauna are probably correlatives because both contain *D. pacificus* and *Simimeryx* and are transitional faunas with taxa characteristic of the late Uintan and early Duchesnean. The Chestnut Avenue Local Fauna may also be latest Uintan or earliest Duchesnean in age because it contains *S. sp.*, cf. *S. hudsoni*, and lies above the late Uintan Laguna Riviera Local Fauna.

The Laguna Riviera, Strathern, and Pearson Ranch Local Faunas contain four species in common (*Simidectes merriami*, *Proterixoides davisii*, *Dyseolemur pacificus*, *Protoreodon* “*pumilus*”), whereas the Laguna Riviera and the Brea Canyon Local Faunas contain ten species in common [*Peratherium* sp., cf. *P. knighti* McGrew, 1959; *Peradectes californicus* (Stock, 1936a); *Sespedectes singularis*; *Proterixoides davisii*; *Dyseolemur pacificus*; *Protoreodon* “*pumilus*”; *Leptoreodon pusillus*; *Protylopus? robustus*; *Protylopus* sp., cf. *P. petersoni* Wortman, 1898; *Protylopus stocki*]. The Laguna Riviera and Brea Canyon Local Faunas also contain *Amynodon*.

Golz (1976) correlated the Laguna Riviera Local Fauna with the late Uintan Brea Canyon Local Fauna based on the common occurrences of *D. pacificus* and *P. “pumilus”*, both of which are now known to be present in the latest Uintan or earliest Duchesnean Strathern Local Fauna. However, Lander (in lit., personal communication) considers specimens of *P. “pumilus”* from the Laguna Riviera Local Fauna to be more derived than those of *P. “pumilus”* from the Brea Canyon Local Fauna. Nevertheless, the composition of the Laguna Riviera Local Fauna exhibits a much greater affinity with the late Uintan Brea Canyon Local Fauna than the Strathern or Pearson Ranch Local Fauna and supports Golz’s (1976) conclusion that the Laguna Riviera Local Fauna is a correlative of the Brea Canyon Local Fauna and late Uintan in age.

The Tapo Canyon and the Laguna Riviera Local Faunas have five species in common (*Peratherium* sp., cf. *P. knighti*; *Sespedectes singularis*; *Proterixoides davisii*; *Dyseolemur pacificus*; *Protoreodon*

“*pumilus*”), whereas the Tapo Canyon and the Brea Canyon Local Faunas have seven species in common [*Peratherium* sp., cf. *P. knighti*; *Sespedectes singularis*; *Proterixoides davisii*; *Tapocyon occidentalis*; *Dyseolemur pacificus*; *Tapochoerus egressus* (Stock, 1934b); *Leptoreodon stocki* n. sp.]. However, the Tapo Canyon Local Fauna contains at least 13 other species (see above) that do not occur in either the Brea Canyon or Laguna Riviera Local Faunas. Golz (1976) suggested the Tapo Canyon Local Fauna represents an older assemblage than the Laguna Riviera Local Fauna, based on the observation that *Leptoreodon edwardsi* from LACM(CIT) loc. 180 is more primitive than *L. leptolophus* from the Laguna Riviera Local Fauna. Wilson (1949) considered the rodent *Eohaplomys tradux* from the Tapo Canyon Local Fauna to be more primitive than *E. matutinus* and *E. serus* from the Brea Canyon Local Fauna. Golz (1976) considered the faunal differences between the Brea Canyon and Tapo Canyon Local Faunas the result of local environmental differences. It is more likely that these faunal differences reflect age differences because the Tapo Canyon Local Fauna lies about 50 to 100 m below the Brea Canyon Local Fauna and contains species that are more primitive than those from the Brea Canyon Local Fauna. The faunal and stratigraphic evidence indicate the Laguna Riviera and Brea Canyon Local Faunas are younger than the Tapo Canyon Local Fauna.

Walsh (1987) considered the Cloud 9 Fauna from the southern outcrops of the Mission Valley Formation in the San Diego area to show greater similarities with the late Uintan Tapo Ranch Fauna (= Tapo Canyon and Brea Canyon Local Faunas) and late Uintan Laguna Riviera Local Fauna than the early Uintan Poway Fauna. The Cloud 9 and Poway Faunas contain three taxa not found in the Tapo Canyon or Brea Canyon Local Faunas (*Batodonoides powayensis* Novecek, 1976, *Uintasorex* sp., *Protoreodon* sp., cf. *P. parvus* Scott and Osborn, 1887). The Cloud 9 Fauna contains six species in common with the Tapo Canyon and Brea Canyon Local Faunas (*Peratherium* sp., cf. *P. knighti*; *Peradectes californicus*; *Sespedectes singularis*; *Proterixoides davisii*; *Dyseolemur pacificus*; *Simimys simplex*). In addition, the Cloud 9 Fauna and Tapo Canyon Local Fauna contain *Apatemys*, *Microparamys* “sp. D”, and *Eohaplomys*. Walsh (1987) considers *Eohaplomys* sp. of the Cloud 9 Fauna to be most closely related to *E. tradux* of the Tapo Canyon Local Fauna. The presence of *Simidectes* in the Cloud 9 Fauna (Walsh, 1987), a taxon whose first appearance is regarded as diagnostic of the late Uintan by Krishtalka *et al.* (1987), further supports a late Uintan age.

The Cloud 9 Fauna and the Laguna Riviera Local Fauna contain only two species in common (*Sespedectes singularis*, *Dyseolemur pacificus*). Moreover, *P. “pumilus”* from the Laguna Riviera Local Fauna is more advanced than *P. sp.*, cf. *P. parvus*, of the Cloud 9 and Poway Faunas (Golz, 1976;

Lander, in lit., personal communication in Walsh, 1987). The Cloud 9 Fauna exhibits greater affinities with the Tapo Canyon Local Fauna than with the Brea Canyon and Laguna Riviera Local Faunas; however, the Cloud 9 Fauna is probably slightly older than the Tapo Canyon Local Fauna because it contains species (*B. powayensis*; *P. sp.*, cf. *P. parvus*) elsewhere known only from the early Uintan Poway Fauna. Based on the above data and the observations presented by Walsh (1987), the Cloud 9 Fauna is herein regarded as early late Uintan in age.

Stock (1938) reported the presence of *Teleodus* sp., cf. *T. californicus*, from LACM(CIT) loc. 292, which is in the massive sandstones of the Sespe Formation exposed along upper Sespe Creek, north of Ojai, Ventura County, California. The sample of *Teleodus* from LACM(CIT) loc. 292 is herein referred to *Duchesneodus* sp., cf. *D. californicus*, as recognized by Lucas and Schoch (1982). Fieldwork conducted in the upper Sespe Creek area by the author resulted in the recovery of *Amynodontopsis* from a siltstone overlying LACM(CIT) loc. 292. The assemblage from LACM(CIT) loc. 292 and vicinity, identified herein as the Sespe Creek Local Fauna, is Duchesnean in age and probably a correlative of the Pearson Ranch Local Fauna, based on the common occurrences of *Duchesneodus* and *Amynodontopsis*.

Lindsay (1968) described a rodent assemblage from the Hartman Ranch Local Fauna at UCMP loc. V-5814 in the lower part of the Sespe Formation in the upper Sespe Creek area. Lindsay (1968) reported that the fossil-bearing horizon is in a transitional zone, in which the Sespe Formation intertongues with the underlying marine Coldwater Sandstone. Mason (1988) reported UCMP loc. V-5814 is stratigraphically far below LACM(CIT) loc. 292 and is actually in strata now mapped as Coldwater Sandstone by Vedder *et al.* (1972). Lindsay (1968) correlated the Hartman Ranch Local Fauna, which contains *Pareumys* sp., "*Namatomys*" *fantasma* (Lindsay, 1968), *Griphomys* sp., and *Simimys* sp., with the Tapo Ranch Fauna (= Brea Canyon and Tapo Canyon Local Faunas) and assigned it to the Uintan. Lindsay (1968) considered *Pareumys* sp. and *Simimys* sp. from the Hartman Ranch Local Fauna to be most closely related to *Pareumys* sp. and *Simimys murinus*, respectively, from the Tapo Ranch Fauna. However, the distinctiveness of *Pareumys* sp. from the Tapo Ranch and Brea Canyon Local Faunas and *Pareumys* sp., aff. *P. milleri*, of late Uintan to early Duchesnean age is now questioned (see above). Moreover, Lillegraven and Wilson (1975) analyzed the diagnostic dental characters and measurements of a large sample of *Simimys* from the latest Uintan or earliest Duchesnean Camp San Onofre Local Fauna and found that all species of the genus fit within the range of variation observed in the Camp San Onofre sample. It was concluded that only one species of *Simimys*—*S. simplex*—is present in southern California. The

Hartman Ranch Local Fauna may be late Uintan in age because it occurs well below the Duchesnean Sespe Creek Local Fauna; however, the faunal evidence does not eliminate an early Duchesnean age assignment.

TEXAS

The Serendipity Local Fauna, from the Agua Fria-Green Valley area in Texas, and the Tapo Ranch and the Brea Canyon Local Faunas have the shared occurrences of *Leptoreodon edwardsi* and *L. pusillus*, respectively (Wilson, 1986). However, *L. pusillus* is also reported from the Whistler Squat Local Fauna in the Agua Fria-Green Valley area, where it is bracketed by K-Ar dates of 44.0 ± 0.9 Ma above, and 46.9 ± 1.1 and 48.6 ± 1.3 Ma below (McDowell, 1979; Stevens *et al.*, 1984; Wilson, 1986). The Serendipity Local Fauna lies above the early Uintan Whistler Squat Local Fauna and the tuff dated at 44.0 ± 0.9 Ma, and below a tuff K-Ar dated at 42.7 Ma (Wilson, 1986). Wilson (1986) considered the Serendipity Local Fauna to be late Uintan in age. The faunal composition suggests the fauna is early late Uintan in age and a correlative of the Cloud 9 Fauna from the greater San Diego area.

Wilson (1986) also correlated the Serendipity Local Fauna with the Candelaria Local Fauna from the Vieja-Ojinaga area in Texas. The Candelaria Local Fauna is bracketed by K-Ar dates of 39.7 ± 1.2 Ma above and 41.2 ± 2 Ma below (Wilson *et al.*, 1968). The radiometric dates bracketing these faunas suggest that the Serendipity Local Fauna is older than Candelaria Local Fauna.

Wilson (1977, 1984, 1986) assigned the Candelaria Local Fauna to the Uintan, based on the presence of *Ephippus* sp., cf. *E. gracilis* Marsh, 1871; *Dilophodon* sp., cf. *D. leotanus* (Peterson, 1931); *Protoreodon petersoni* Gazin, 1955; and *Leptoreodon leptolophus*. The Candelaria and late Uintan Laguna Riviera Local Faunas have the shared occurrence of *Leptoreodon leptolophus*. Wood (1974) considered the rodents of the Candelaria Local Fauna to be late Uintan but post-Myton in age. *Dilophodon* is also present in the late Uintan Tapo Canyon and Laguna Riviera Local Faunas. Lander (in lit.) considers the specimens from the Candelaria Local Fauna, which Wilson (1984, 1986) referred to *Protoreodon petersoni*, to represent a new genus and species of agriochoerid. Lander (in lit.) also considers this new species to be more advanced than species of same genus from late Uintan assemblages of the Myton Member in the Devils Playground area of Utah and assigns the Candelaria Local Fauna to the early Duchesnean. Black (1978) considered the Candelaria Local Fauna Duchesnean in age but older than the Pearson Ranch Fauna and younger than the Tapo Ranch Fauna (= Brea Canyon and Tapo Canyon Local Faunas), the Laguna Riviera Local Fauna, and the Myton Fauna. Krishalka *et al.* (1987) correlate the Candelaria Local

Fauna with the latest Randlett and Halfway Faunas from the Uinta Formation in Utah.

The Candelaria Local Fauna is a transitional fauna that contains taxa known elsewhere in late Uintan faunas (*Dilophodon*, *Epihippus*, *Sthenodectes*); late Uintan and Duchesnean faunas (*Leptoreodon*); and late Uintan, Duchesnean, and Chadronian faunas (*Colodon*, *Metamynodon*, *Ischyrotomus*, *Manitsha*). It is difficult to correlate the Candelaria Local Fauna with the middle and late Eocene faunas of the Pacific Coast; however, this fauna, like the Strathern Local Fauna, may be latest Uintan or earliest Duchesnean in age.

Wilson (1986) correlated the early Duchesnean Pearson Ranch Local Fauna with the Skyline Local Fauna from the Agua Fria-Green Valley area in Texas, based on the common occurrences of *Simidectes*, *Hyaenodon*, *Duchesneodus*, and *Amyndontopsis*. The Skyline Local Fauna occurs in the Skyline Channels, directly above a biotite-bearing ash K–Ar dated at 42.7 Ma (Wilson and Schiebout, 1981; Wilson, 1986). The Strathern Local Fauna appears to be slightly older than the Skyline Local Fauna because of the presence of *Dyseolemur* and the apparent lack of *Duchesneodus* and *Hyaenodon*.

The Porvenir Local Fauna from the Vieja-Ojinaga area occurs above the Buckshot Ignibrite (K–Ar dated at 38.6 ± 1.2 Ma) and below the Bracks Rhyolite (K–Ar dated at 37.7 ± 1.2 Ma) (McDowell, 1979). Krishtalka *et al.* (1987) refer the Porvenir Local Fauna to the Duchesnean, whereas Emry *et al.* (1987) regard this local fauna as earliest Chadronian. The Porvenir Local Fauna contains certain taxa (*Mesohippus*, *Archaeotherium*, *Pseudoprotoceras*, *Leptomeryx*) found elsewhere only in Chadronian faunas (Emry *et al.*, 1987). The Porvenir Local Fauna appears to be younger in age than the type Duchesnean Lapoint Fauna, based on its greater similarity to Chadronian faunas. The Porvenir Local Fauna is herein regarded as latest Duchesnean to earliest Chadronian in age.

WYOMING

Correlation of the Pacific Coast middle and late Eocene land mammal assemblages with those from the Hendry Ranch Member of the Wagon Bed? Formation from the Badwater area in Wyoming is difficult because of differing faunal compositions and the lack of radiometric dates (Black, 1978; Wilson, 1977). Black (1978) concluded the fauna from Badwater localities 5, 6, and 7 correlate best with the late Uintan Myton Fauna of Utah, the Tapo Ranch Fauna (= Brea Canyon and Tapo Canyon Local Faunas), and the Laguna Riviera Local Fauna. The common occurrence of *Tapocyon* in the fauna from Badwater localities 5, 6, and 7 (Dawson, 1980), the Tapo Canyon and Brea Canyon Local Faunas (this report), and the Myton Fauna (Mason, 1988) suggest these faunas are correlatives.

Black (1969, 1978) considered the assemblage

from Badwater locality 20, which is associated with a tuff K–Ar dated at 42.3 ± 1.4 Ma, and most probably those from the Badwater Wood and Rodent localities, to be younger than the fauna from Badwater localities 5, 6, and 7 but older than the Pearson Ranch Fauna. The assemblages from Badwater locality 20 and the Wood and Rodent localities have yielded a diverse fauna, which includes *Peratherium*, *Peradectes*, *Apternodus*, *Trogolemur*, *Chumashius*, *Macrotarsius*, *Daphoenus*, *Epihippus*, *Telmatherium*, *Diplobunops*, *Leptotragulus*, *Poabromylus*, *Hendryomeryx*, *Microparamys*, *Leptotomus*, *Spurimus*, *Pareumys*, *Pseudocylindrodon*, and *Griphomys* sp. (see Black, 1969, 1971, 1974, 1978, 1979; Black and Dawson, 1966b; Dawson, 1974, 1980; Krishtalka, 1978; Krishtalka and Setoguchi, 1977; Krishtalka and Stucky, 1983; Maas, 1985; MacFadden, 1980; Robinson, 1966, 1968; Setoguchi, 1975).

The assemblages from Badwater locality 20 and the Wood and Rodent localities are transitional in age because they contain a combination of late Uintan and Duchesnean taxa; however, the presence of certain taxa (*Apternodus*, *Daphoenus*, *Poabromylus*, *Pseudocylindrodon*) indicates a Duchesnean age for these assemblages. Wilson (1986) assigned the Skyline and Pearson Ranch Local Faunas, and the assemblages from Badwater locality 20 and the Wood locality to the early Duchesnean. A K–Ar date of 42.7 Ma (Wilson and Schiebout, 1981; Wilson, 1986) from an ash lying immediately below the Skyline Local Fauna and the date of 42.3 Ma for the tuff associated with the assemblage from Badwater locality 20 (Black, 1969, 1978) also suggest these assemblages are correlatives. The assemblages from Badwater locality 20 and the Wood and Rodent localities are herein regarded as early Duchesnean and probable correlatives of the Skyline and Pearson Ranch Local Faunas.

UTAH

The Myton Fauna from the Myton Member of the Uinta Formation and the Randlett Fauna of the Brennan Basin Member of the overlying Duchesne River Formation in Utah are considered late Uintan. The age of the Halfway Fauna, in part from the overlying Dry Gulch Creek Member of the Duchesne River Formation, has been questioned, and its assignment to the Uintan is not unequivocal (see above).

The Myton Fauna appears to correlate with the Randlett Fauna because of shared occurrences of certain species [*Petacemylus progressus* Peterson, 1931; *Protoreodon* “*pumilus*”; *Mytonomys robustus* (Peterson, 1919)] and genera (*Epihippus*, *Amyndodon*, *Epitriplopus*, *Dilophodon*, *Diplobunops*, *Leptotomus*, *Mytonolagus*) (Gazin, 1955; Dawson, 1966; Tedford, 1970; Emry, 1981; Andersen and Picard, 1972; Krishtalka *et al.*, 1987). The Myton Fauna is difficult to correlate with the middle Eocene assemblages from the Pacific Coast and Texas be-

cause of the lack of shared species and radiometric dates. The Tapo Canyon and Brea Canyon Local Faunas may correlate with the Myton Fauna based on the joint occurrences of *Tapocyon*, *Procyonodictis*, *Protoreodon* "*pumilus*", and *Thisbemys*. Furthermore, *Ischyrotomus compressidens* (Peterson, 1919) of the Myton Fauna is very similar to *I. sp.*, near *I. compressidens* of the Tapo Canyon Local Fauna.

The Lapoint Fauna of the Duchesne River Formation is younger than the early Duchesnean Pearson Ranch Local Fauna and is regarded herein as late Duchesnean in age (see above).

SUMMARY

Four Eocene local faunas are now recognized in the lower part of the middle member of the Sespe Formation in Simi Valley, Ventura County, California. The Tapo Canyon Local Fauna is the oldest and is comprised of the assemblages from within about 20 m of bed CS1. The overlying Brea Canyon Local Fauna is present in beds CS2 through CS6. The Strathern Local Fauna (new) is present in beds CS8 through CS14. The Pearson Ranch Local Fauna (restricted) is present in the upper half of bed SS15 through bed SS22.

The biostratigraphic framework developed herein will allow subsequent workers to use the faunas from the Sespe Formation with greater precision when conducting biostratigraphic and evolutionary studies. An ongoing mitigation project at the Simi Valley Landfill by Waste Management of North America, Inc. is resulting in the recovery of stratigraphically superposed samples of small mammals from the Sespe Formation. Future study of these samples will provide additional data on the geologic ranges of taxa from the Sespe Formation and further clarify the Uintan–Duchesnean boundary in Simi Valley.

The study summarized herein documents taxa that had not previously been recorded from the Brea Canyon Local Fauna (*Leptoreodon pusillus*; *Protylopus?* sp., cf. *P.?* *robustus*) and the range extensions of *Leptoreodon* and *Rapamys* from the late Uintan into the Duchesnean. The present study also resulted in the discovery of two new species: *Leptoreodon stocki*, which is present in the Tapo Canyon, Brea Canyon, Strathern, and the Pearson Ranch Local Faunas, and *Macrotrarsius roederi* from the Brea Canyon Local Fauna.

The Brea Canyon and Tapo Canyon Local Faunas are late Uintan in age; however, the Tapo Canyon Local Fauna, which occurs below the Brea Canyon Local Fauna and contains a less derived fauna, is slightly older. The latest Uintan or earliest Duchesnean Strathern Local Fauna is transitional and contains a combination of characteristic Uintan and Duchesnean taxa. The early Duchesnean is characterized by the first appearances of *Hyaenodon*, *Duchesneodus*, and *Amynodontopsis* and in-

cludes the Pearson Ranch Local Fauna. The late Duchesnean is characterized by the first appearances of *Hyracodon*, *Brachyhyops*, and *Agriochœrus* and the last occurrences of *Duchesneodus* and *Amynodontopsis*, and is represented by the Lapoint Fauna of Utah.

The Eocene faunas from the Sespe Formation appear to correlate with other Eocene assemblages from southern California as follows: the Chestnut Avenue Local Fauna from the Carlsbad area and the Camp San Onofre Local Fauna from Camp Pendleton are probably correlatives of the Strathern Local Fauna; the Laguna Riviera Local Fauna from the Carlsbad area appears to correlate with the Brea Canyon Local Fauna; the Sespe Creek Local Fauna from the upper Sespe Creek area is probably a correlative of the Pearson Ranch Local Fauna; the Hartman Ranch Local Fauna from the upper Sespe Creek area is probably late Uintan in age and may correlate with the Brea Canyon Local Fauna.

The Eocene faunas from the Vieja-Ojinaga area in Texas appear to be related to the Pacific Coast assemblages as follows: the Candelaria Local Fauna may be a correlative of the Strathern Local Fauna; the Porvenir Local Fauna is younger than the Pearson Ranch Local Fauna and is latest Duchesnean or earliest Chadronian in age.

The Eocene assemblages from the Agua Fria-Green Valley area in Texas appear to correlate with the Pacific Coast assemblages as follows: the Whistler Squat Local Fauna is a correlative of the Poway Fauna from the greater San Diego area; the Serendipity Local Fauna is a possible correlative of Cloud 9 Fauna from the greater San Diego area; the Skyline Local Fauna is a correlative of the Pearson Ranch Local Fauna.

The late Uintan assemblages from the Hendry Ranch Member of the Wagon Bed? Formation at Badwater localities 5, 6, and 7 in Wyoming are difficult to correlate with any single local fauna in southern California because of faunal differences. The assemblages from the Hendry Ranch Member at Badwater locality 20 and the Rodent and Wood localities appear to be correlatives with the Pearson Ranch Local Fauna and are early Duchesnean in age.

The Myton Fauna of the Uinta Formation in Utah is difficult to correlate with any local fauna in southern California but appears, in general, to correlate with the Brea Canyon and Tapo Canyon Local Faunas.

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- Descriptions and stratigraphic horizons of LACM(CIT) localities in the Sespe Formation from Simi Valley, as well as the taxa these localities yielded during the present study.
- LACM(CIT) loc. 127. Lat. 34°17'37"N; Long. 118°46'52"W. East side, Brea Canyon, elevation approximately 314 m, bed CS4, middle member, Sespe Formation. LACM(CIT) loc. 127 occurs in a small basin of badlands just west of the canyon containing LACM(CIT) loc. 151 (Fig. 1). Taxa: *Protoreodon* sp.; *Leptoreodon stocki* n. sp.
- LACM(CIT) loc. 128. Lat. 34°17'47"N; Long. 118°47'19"W. West side, Brea Canyon, 104 m S 23°W from the top of the most southerly Unocal oil well (CDLB #3) in Brea Canyon, elevation approximately 290 m, beds CS13 and CS14, middle member, Sespe Formation. Most of the fossils collected by the CIT personnel at LACM(CIT) loc. 128 came from bed CS13; however, a few specimens were recovered from bed CS14. Taxa: *Sespedectes singularis*; *Dyseolemur pacificus*; *Protoreodon* "pumilus"; *Leptoreodon stocki* n. sp.; *Simimeryx hudsoni*; Artiodactyla gen. and sp. indet.
- LACM(CIT) loc. 145. Lat. 34°17'51"N; Long. 118°47'20"W. West side, Brea Canyon, 84 m S 68°W of the most southerly Unocal oil well (CDLB #3) in Brea Canyon, elevation approximately 305 m, bed SS18, middle member, Sespe Formation. Photographs made during the original CIT investigations indicate the primary fossiliferous horizon referred to LACM(CIT) loc. 145 is bed SS18; however, a few specimens were recovered from the beds immediately above and below bed SS18. Taxa: Trionychidae gen. and sp. indet.; *Amynodontopsis bodei*; Artiodactyla gen. and sp. indet.
- LACM(CIT) loc. 146. Lat. 34°17'49"N; Long. 118°47'22"W. West side, Brea Canyon, 169 m S 72°W of the most southerly Unocal oil well (CDLB #3) in Brea Canyon, elevation approximately 293 m, bed SS16, middle member, Sespe Formation. This locality is in the lowest outcrop of white sandstone in the extreme southwest corner of the small canyon containing LACM(CIT) loc. 145. Taxa: *Sespedectes singularis*; *Chumashius balchi*; *Amynodontopsis bodei*; *Protylopus* sp.; *Leptoreodon stocki* n. sp.; Rodentia gen. and sp. indet.
- LACM(CIT) loc. 147. Lat. 34°17'57"N; Long. 118°47'08"W. West side, Brea Canyon, 241 m N 49°E of the most southerly Unocal oil well (CDLB #3) in Brea Canyon, elevation approximately 317 m, bed SS21, middle member, Sespe Formation. This locality is in small exposure of red and green sandstone immediately below the CDLB fault. Taxa: *Protylopus pearsonensis*; Mammalia gen. and sp. indet.
- LACM(CIT) loc. 148. Lat. 34°17'52"N; Long. 118°47'04"W. West side, Brea Canyon, 372 m N 75°E of the most southerly Unocal oil well (CDLB #3) in Brea Canyon, elevation approximately 290 m, bed CS16, middle member, Sespe Formation. This locality is in the red claystone that overlies the conglomerate (SS16) that produces prominent oil seeps. Taxa: Rodentia gen. and sp. indet.; Mammalia gen. and sp. indet.
- LACM(CIT) loc. 149. Lat. 34°18'03"N; Long. 118°47'11"W. West side, Brea Canyon, 395 m N 25.5°E of the most southerly Unocal oil well (CDLB #3) in Brea Canyon, elevation approximately 335 m, bed CS8?, middle member, Sespe Formation. This locality is located just

above the CDLB fault in vertically uplifted strata that repeat strata below the fault. The exact stratigraphic position of LACM(CIT) loc. 149 can only be estimated. Based on the known vertical displacement of the fault, the bed that contains LACM(CIT) loc. 149 is probably equivalent to bed CS8 below the fault. Taxa: *Leptoreodon* sp. indet.; Mammalia gen. and sp. indet.

LACM(CIT) loc. 150. Lat. 34°17'53"N; Long. 118°47'26"W. Quarry near the head of of unnamed canyon between Brea and Alamos Canyons, 369 m N 81°W of the most southerly Unocal oil well (CDLB #3) in Brea Canyon, elevation approximately 290 m, bed CS20, middle member, Sespe Formation. This locality was destroyed by the Simi Valley Landfill operation. See the original CIT photographs of LACM(CIT) locs. 150, 150E, 150W, and 150.5, in the "Sespe Excavations 1933" on file at the LACM.

LACM(CIT) loc. 150E (east). Lat. 34°17'53"N; Long. 118°47'21"W. Approximately 201 m east of LACM(CIT) loc. 150 at east edge of unnamed canyon between Brea and Alamos Canyons, elevation approximately 320 m, bed CS20, middle member, Sespe Formation. LACM(CIT) loc. 150E is one of the few localities that has not yet been destroyed by the Simi Valley Landfill operation. See CIT photographs 577 and 588 in "Sespe Excavations 1933" on file at the LACM. Taxa: *Simimeryx hudsoni*; Rodentia gen. and sp. indet.

LACM(CIT) loc. 150W (west). Lat. 34°17'53"N; Long. 118°47'28"W. 92 m west of LACM(CIT) loc. 150 at the bottom of unnamed canyon between Brea and Alamos Canyons, approximate elevation 280 m, bed CS20, middle member, Sespe Formation. LACM(CIT) loc. 150W was destroyed by the Simi Valley Landfill operation.

LACM(CIT) loc. 150.5. Lat. 34°17'53"N; Long. 118°47'23"W. Geographically between LACM(CIT) locs. 150 and 150E in unnamed canyon between Brea and Alamos Canyons, approximate elevation 297 m, bed CS20, middle member, Sespe Formation. LACM(CIT) loc. 150.5 was destroyed by the Simi Valley Landfill operation. See CIT photograph 586 in the "Sespe Excavations 1933" on file at the LACM.

LACM(CIT) loc. 151. Lat. 34°17'37"N; Long. 118°46'52"W. East side, Brea Canyon, 767 m S 56°E of the most southerly Unocal oil well (CDLB #3) in Brea Canyon, elevation approximately 314 m, bed CS4, middle member, Sespe Formation. Taxa: *Protoreodon* "*pumilus*"; *Leptoreodon stocki* n. sp.

LACM(CIT) loc. 152. Lat. 34°17'49"N; Long. 118°46'16"W. East side, Brea Canyon, 1590 m S 87.5°E of the most southerly Unocal oil well (CDLB #3) in Brea Canyon, elevation approximately 330 m, bed CS5?, middle member, Sespe Formation. LACM(CIT) loc. 152 is located just above the CDLB fault in vertically uplifted strata that repeat strata below the fault. Based on similar lithologies, the stratigraphic position of LACM(CIT) loc. 152 is estimated to correlate with bed CS5 below the fault. Taxon: Mammalia gen. and sp. indet.

LACM(CIT) loc. 154. Lat. 34°17'29"N; Long. 118°47'26"W. West side, Brea Canyon, 762 m S 11°W of the most southerly Unocal oil well (CDLB #3) in Brea Canyon, elevation approximately 290 m, bed CS1, middle member, Sespe Formation. LACM(CIT) loc. 154 is in west side of Brea Canyon along the face of a cliff about 61 m

above the canyon floor. The Conejo Volcanics, a Miocene intrusive unit, is exposed in this cliff face below LACM(CIT) loc. 154. Taxon: Mammalia gen. and sp. indet.

LACM(CIT) loc. 179. Lat. 34°17'38"N; Long. 118°48'11"W. 805 m east of Alamos Canyon in east fork of small tributary canyon, elevation approximately 302 m, bed CS15, middle member, Sespe Formation. Apparently, the original sample of fossils collected from LACM(CIT) loc. 179 was misplaced or lost during the transfer of the CIT collection to LACM. Taxon: *Protoreodon pacificus*. Also, Roeder (1982) collected a specimen, which he identified as Carnivora sp. indet., from this locality.

LACM(CIT) loc. 180. Lat. 34°18'20"N; Long. 118°44'21"W. East side, Dry Canyon, 4.67 km N 39.5°W of Santa Susana benchmark 961, elevation approximately 427 m, bed CS1?, middle member, Sespe Formation. Extensive fieldwork conducted for the present study indicates LACM(CIT) loc. 180 occurs very low in the middle member, just above the contact between the lower and middle members, and at about the stratigraphic level of bed CS1 in Brea Canyon. However, the exact stratigraphic position relative to the Brea Canyon section can only be estimated to be within 20 m of bed CS1. This locality yielded the majority of specimens assigned to the Tapo Canyon Local Fauna.

LACM(CIT) loc. 202. Lat. 34°17'32"N; Long. 118°47'38"W. Unnamed canyon between Brea and Alamos Canyons, elevation approximately 267 m, bed CS3, middle member, Sespe Formation. LACM(CIT) loc. 202 was destroyed by the Simi Valley Landfill operation. The precise stratigraphic positions of LACM(CIT) locs. 202 and 207 were determined by identifying still-existing exposures of the fossiliferous horizons from CIT photographs 653 and 654 of the original localities and by tracing individual beds from new exposures in the Simi Valley Landfill to exposures in Brea Canyon.

LACM(CIT) loc. 202E (east). Lat. 34°17'32"N; Long. 118°47'36"W. Just east of LACM(CIT) loc. 202 in unnamed canyon between Brea and Alamos Canyons, elevation approximately 275 m, bed CS3, middle member, Sespe Formation. LACM(CIT) loc. 202E was destroyed by the Simi Valley Landfill operation.

LACM(CIT) loc. 202W (west). Lat. 34°17'31"N; Long. 118°47'40"W. Just west of LACM(CIT) loc. 202 in unnamed canyon between Brea and Alamos Canyons, approximate elevation 259 m, bed CS3, middle member, Sespe Formation. LACM(CIT) loc. 202W was destroyed by the Simi Valley Landfill operation.

LACM(CIT) loc. 207. Lat. 34°17'33"N; Long. 118°47'40"W. Approximately 23 m below LACM(CIT) loc. 202 in unnamed canyon between Brea and Alamos Canyons, elevation approximately 244 m, bed CS2, middle member, Sespe Formation. LACM(CIT) loc. 207 was destroyed by the Simi Valley Landfill operation. See the CIT photographs 653 and 654 in the "Sespe Excavations 1933" on file at the LACM.

LACM(CIT) loc. 217. Lat. 34°18'44"N; Long. 118°44'59"W. West side, Dry Canyon, 5.15 km N 46°W of Santa Susana benchmark 961, stratigraphically just above LACM(CIT) loc. 180, elevation approximately 389 m, bed CS1?, middle member, Sespe Formation. Horizon estimated to be equivalent to one within 20 m of bed CS1 in Brea Canyon.

LACM(CIT) loc. 218. Lat. $34^{\circ}17'44''\text{N}$; Long. $118^{\circ}48'00''\text{W}$. Unnamed canyon between Brea and Alamos Canyons, 5.23 km S 60°W of Simi Valley benchmark

2231, elevation approximately 274 m, bed CS15, middle member, Sespe Formation. LACM(CIT) loc. 218 was destroyed by the Simi Valley Landfill operation.